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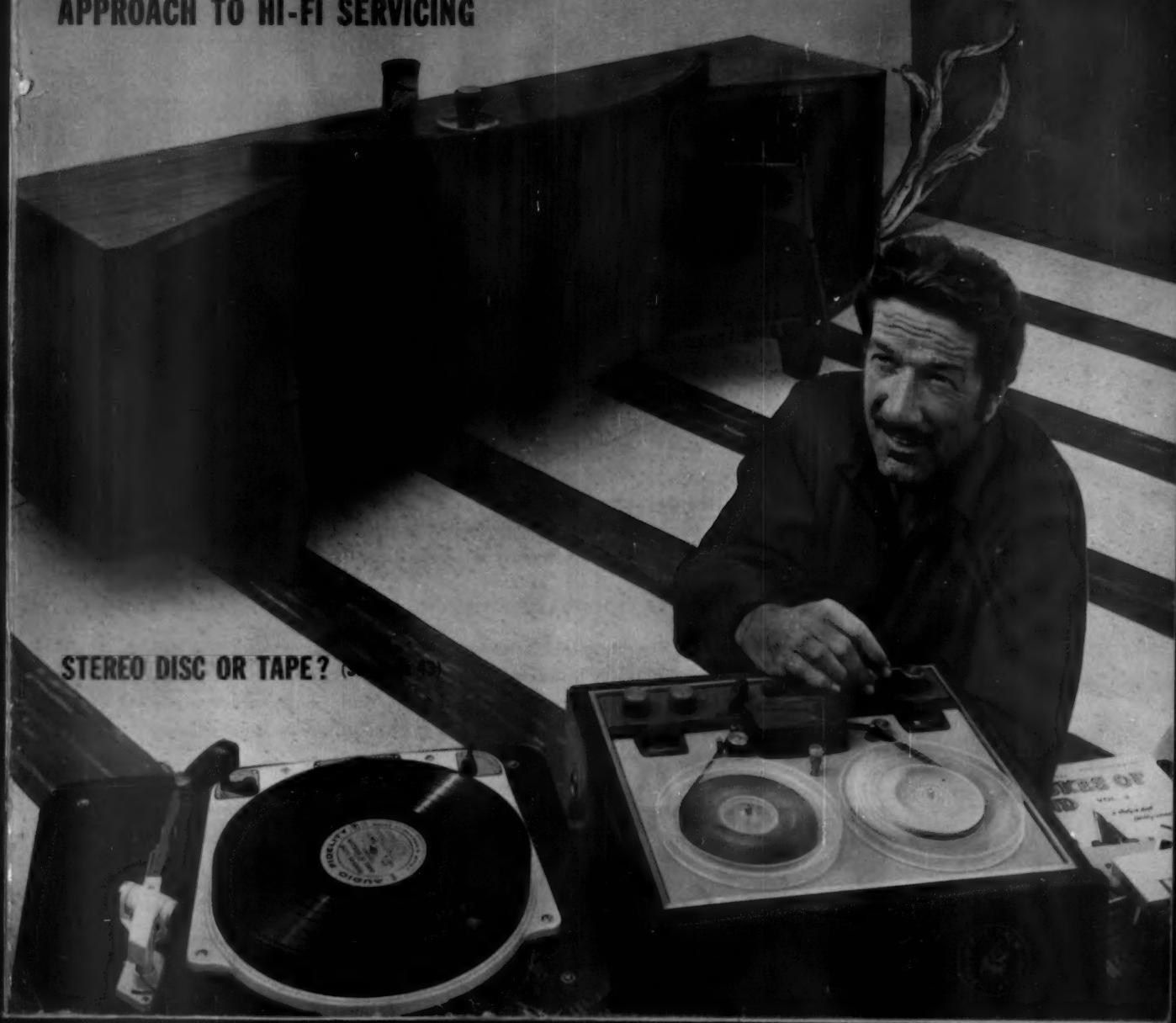
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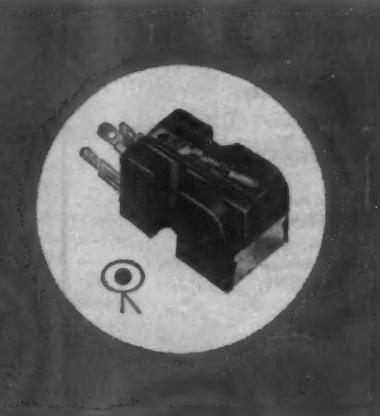
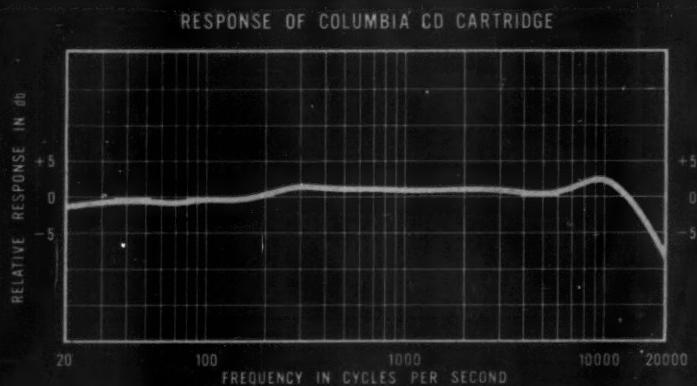
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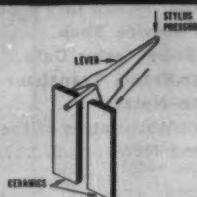
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ZIFF-DAVIS PUBLISHING COMPANY
William Ziff, President; W. Bradford Briggs, Vice-President; Michael Michaelson, Vice-President and Circulation Director; Hershel S. Sarbin, Secretary; Albert Gruen, Art Director.

Editorial and Executive Offices
One Park Avenue
New York 16, N.Y. OR. 9-7200

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BRANCH OFFICES: Midwestern Office, 424 S. Wabash Ave., Chicago 5, Ill.; Western Office, Room 412, 215 W. 7th St., Los Angeles 14, Calif.; John E. Payne, manager.

FOREIGN ADVERTISING REPRESENTATIVES: D. A. Goodall Ltd., London; Albert Mihado & Co., Antwerp and Dusseldorf.

First in radio-television-audio-electronics

Average Net Paid Circulation 246,225

Radio & Television News • Radio News • Television News Trademarks Reg. U. S. Pat. Off.

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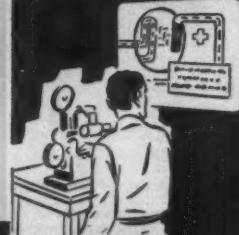
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...for the Record

By W. STOCKLIN
Editor



STEREO TAPE OR DISC?

SO "stereo discs will take over the tape recorder market and all tape recorders in the hands of the public today will become obsolete." This is the rumor but there is no basis for it. Actually, stereo discs and tape will not be competitive but will augment each other.

The stereo disc is, without a doubt, one of the biggest things to hit the hi-fi field. It will appeal to the mass market but for those who want top-quality reproduction and for those who want to do their own home recording, tape will be the answer. The problem with the stereo disc is not in the playback equipment. Cartridges, amplifiers, and speakers are designed today to reproduce quality far beyond anything presently available on the stereo disc. Manufacturers of the discs are the ones who are confronted with the headaches of obtaining comparable quality to that which we are accustomed to on the standard monaural LP record. The Westrex cutter, for example, limits the high-frequency output to near 8000 cps. Recording levels are down at least 3 db (some say 6) from the standard LP and therefore the signal-to-noise ratio must be lower. These are just some of the factors that must be coped with. However, there is no doubt that, in time, these problems will be solved. In fact we know that most disc manufacturers who are using the Westrex cutter have or are making design improvements. Since all companies are working independently in making modifications one will find quite a variation in quality from one label to another—at least for the present.

These factors should in no way detract from the ultimate advantages of stereo. The psychological effect itself, even under lower quality conditions, far surpasses the best monaural LP.

There will be a relatively large number of music lovers who will swing over to stereo. They will be novices in the field of hi-fi and, as a result, we will have to bear with them. They will start where we left off several years ago with railroad trains "passing through" the living room and "ping-pong" effects. This is showmanship in that it trains the uninitiated in the effects of stereo. Not many of the newcomers will understand stereo at the beginning. In fact, they will not even realize the difference between stereo and dual-speaker monaural reproduction. The "sound effects" will help the stereo newcomer.

The tape industry is in a somewhat different situation for the time being. The 4-track head and the tape car-

tridge announced recently and covered in our August, 1958 issue is causing deep concern among the tape and recorder manufacturers. Most of them for the moment are sitting back trying to analyze what the future holds for them. The 4-track head itself is not too much of a problem. Conversion kits are available for many machines in the hands of the public today and it is not too difficult a procedure to convert machines to this mode of operation. The question is whether or not the recorded tape manufacturers will produce sufficient stereo tapes and at what speeds—3.75 ips, 7.5 ips, or both—to satisfy consumer demand.

The tape cartridge is another problem. We know that *Pentron*, *Philco*, *Motorola*, and *RCA* have displayed tape machines for use with the tape cartridge. With the exception of *RCA*, we are not too sure as to the future plans of these companies for marketing this machine. *RCA* announces that its unit should be in production by October 1. However, rumor has it that, because of mechanical and electronic problems yet unsolved, it may not be in production as was originally planned. It seems more likely that it will be some time early next year before all the bugs can be taken out. Since the designs from the other companies are based on the original *RCA* idea, at least so we have heard, it seems unlikely that any tape machine employing a cartridge will be made available to the public this year. Again, the recorded tape companies are deeply concerned—when will it be ready for marketing and how will the consumer take to it?

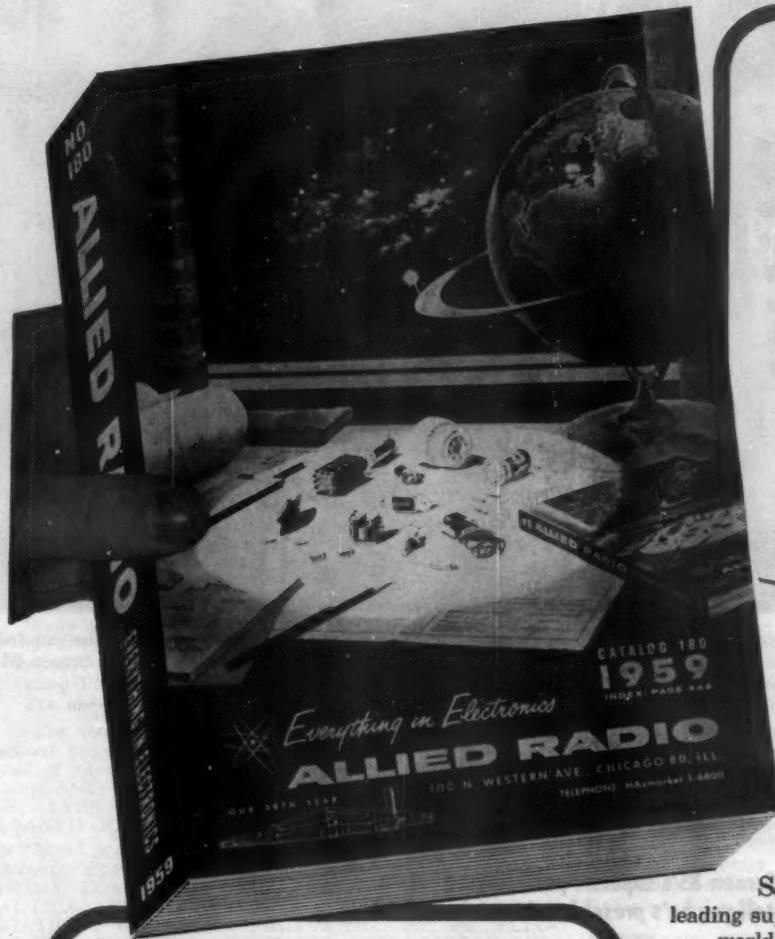
From what we have heard to date the 4-track head at 3.75 ips speed certainly falls below what we would consider hi-fi performance. In response tests recently made, the high end starts dropping off seriously after 8000 to 10,000 cps and the output level is below that obtained with 2-track tape at 7.5 ips. Although several companies have claimed that performance of their 4-track, 3.75 ips machines is equal to what we had in 2-track, 7.5 ips, it is a fact that at higher speeds better performance can be obtained.

We believe that the tape cartridge principle is a sound one but will be more suitable for the mass consumer market than the real hi-fi fan. The 4-track head will also find its place in the industry and we believe that it would be particularly advantageous to those who do a lot of home recording. Its main asset, of course, is not so much

(Continued on page 150)

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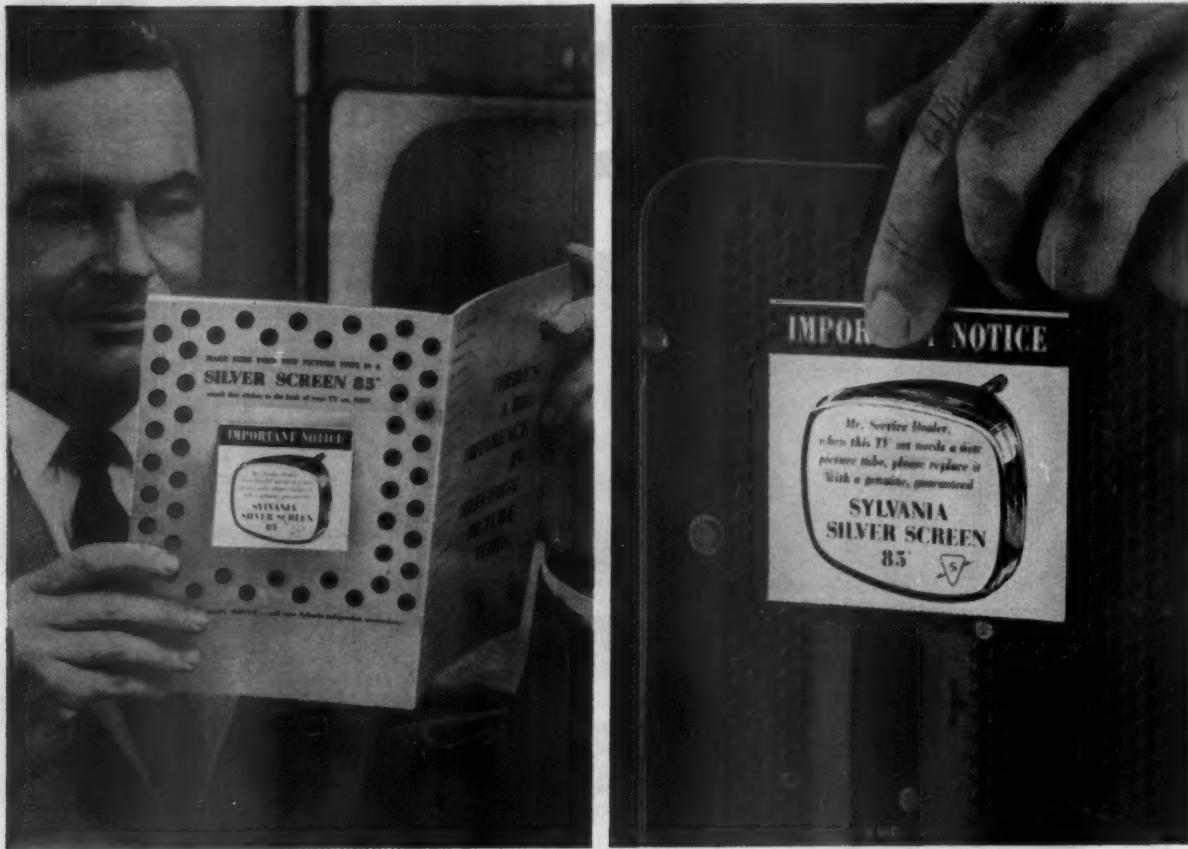
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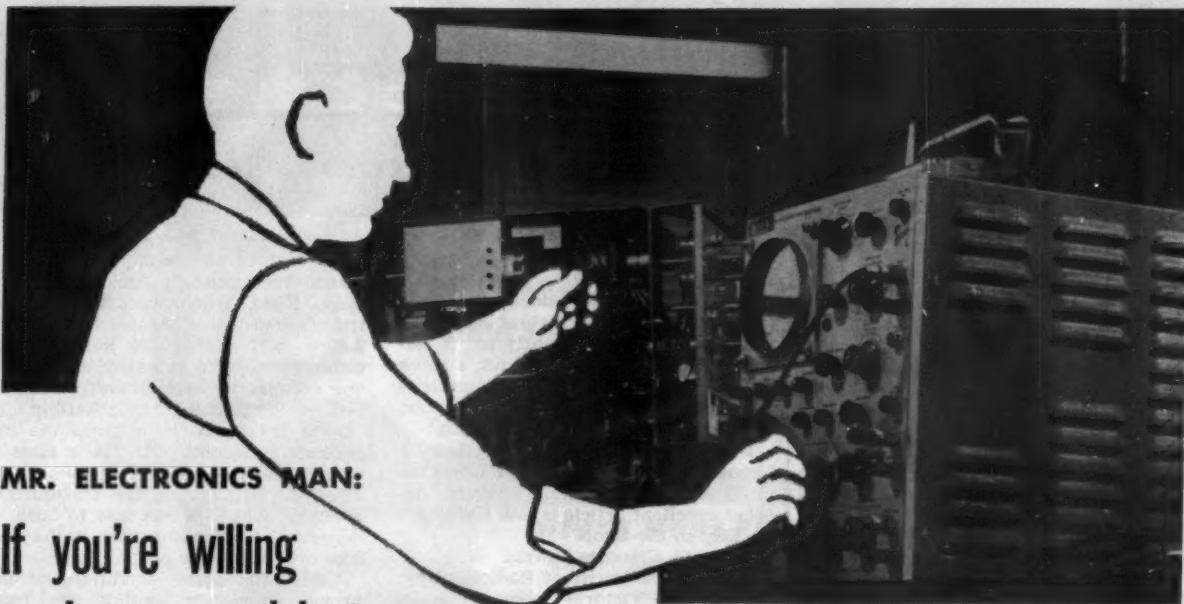


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OUR MAY ISSUE

To the Editors:

Since coming to this side of the world to live, I have found several American technical magazines greatly to my liking, and of *RADIO & TV NEWS*, I think it is very well produced and its articles always clearly written. This, no doubt, bespeaks good technical editorship!

I was particularly interested in Leonard Kaplan's article "A Low-Cost Hi-Fi Amplifier" in the May issue. Another excellent article is Bob Eldridge's "A Day in the Shop."

O. CHARLES SEWELL

Department of Radiotherapy
The Victoria General Hospital
Halifax, N. S., Canada

We will try to continue to merit Reader Sewell's approval.—Editors.

* * *

X-RAY HAZARDS IN TV

To the Editors:

Many TV viewers have expressed concern over possible harmful effects from exposure to the x-rays produced by their picture tubes. If they have something to worry about, what about people like myself? As a technician, I am constantly in the presence of one or several receivers, all operating, and I get pretty close. Just how serious is the x-ray exposure hazard?

L. FLEMING
Los Angeles, Calif.

See "X-Rays from TV Sets: Are They Harmful?" coming in November.—Editors.

* * *

TRANSISTOR MOBILE MODULATOR

To the Editors:

Here are some suggestions for those readers who are constructing the "30-Watt Mobile Modulator" described in the January, 1958 issue. If the output of this unit is distorted, check the transformers for unbalance and incorrect lead coding. This symptom could definitely be caused by a reversal of the zero and two-ohm leads on the driver transformer or the modulator transformer (if the Merit unit is used).

Another item to examine is the pair of mica insulators used to insulate the transistors from the chassis. These sometimes break in handling or are punctured by burrs, allowing a transistor to short to the chassis. Also, the combination of one high- and one low-gain transistor would cause distortion.

A poor waveform when checking the output with a scope, and a subsequent failure of the transistor, may result from operating them into an improperly matched load. In a class B output circuit, two 4-ohm resistors are not

equivalent to an 8-ohm center-tapped transformer primary for several reasons. First, when working into the transformer, each transistor sees a 2-ohm load during its half-cycle of conduction. This is easily seen when one recalls the basic transformer impedance matching relationship of "twice the turns, four times the impedance." Second, since in a class B circuit each transistor conducts on alternate half-cycles, the transformer primary, which is common to both, is necessary to combine both half-cycles into one composite output signal.

Under the above conditions of improper resistance loading, the transistors would deliver only a small output. Reducing bias resistor R_b moves the operating point toward class A operation and improves the quality observed on the scope, but this increases the dissipation, and together with the increased drive, frequently results in transistor failure.

T. A. PREWITT
Kokomo, Indiana

We hope that readers who are building this unit observe Author Prewitt's precautions.—Editors.

* * *

LOW-COST HI-FI AMPLIFIER

To the Editors:

I am contemplating building the hi-fi amplifier described by L. Kaplan in the May issue of *RADIO & TV NEWS*. I would like to use it with a separate preamp, which I have built from a kit. Will I have any problems in doing this? Will the power supply shown be adequate for a preamp?

OLLI K. LAUREN
Kapuskasing, Ontario

If the preamp is self-powered, there will be no problems. It is just a matter of connecting the output of the preamp to the input of the amplifier. With a preamp that draws its power from the power amplifier, however, the following should be considered.

The amplifier will easily supply "B+", which in this case should be connected to the "B+2" point shown in the power-supply circuit. With the transformer specified, adequate heater current is available for preamp tubes as well, but note that the heater center tap is connected to a source of positive voltage (junction of R_h and R_{sh}). This means that if the preamp has a grounded heater supply or grounded hum pot, you must lift this ground.

As an alternative, the ground connection in the preamp may remain as is, but the center tap of the heater winding in the amplifier must be dis-

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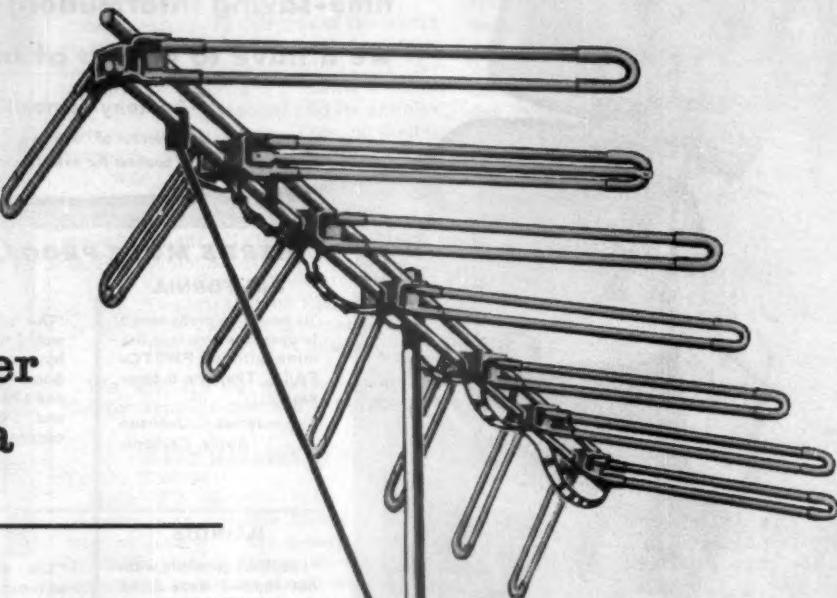
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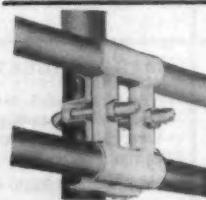


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connected from the junction of R_1 and R_2 and reconnected to ground.—Editors.

TV REMOTE CONTROL

To the Editors:

I have had some correspondence from readers who are building "The Complete TV Remote Control," which I described in the April issue. The following should clear up some of the questions asked.

The correct lamps for the a.f.c. circuit are NE-2's. I have been calling these 1/10th-watt lamps for years, although actually they are 1/25th-watt lamps.

No instability was noticed in the original circuit. However, a friend in trying to duplicate the unit ran into two forms of instability. The first manifested itself as a high-pitched note in the sound. We investigated and found this due to the neon bulbs forming a relaxation oscillator with C_1 , C_2 , and the associated resistors. This can be remedied either by reducing C_1 and C_2 to 10 μfd . each, or by reducing R_{20} and R_{21} .

The second instability appeared as a fluttering. This was traced to the fact that C_1 and C_2 were not mounted adjacent to PL_2 and PL_3 . C_1 and C_2 serve only as r.f. bypasses and, in order to be effective, must be mounted as close as possible to PL_2 and PL_3 . The replacement brass plate is grounded. It is mounted to hold PL_2 and PL_3 in contact with the remaining capacitor plate on the front of the tuner. That is to say, there is no space between the tuner and bulbs, or between the plate and bulbs.

DANIEL P. PETERS
Brooklyn, New York

We are sure this added information will help our readers who are trying to duplicate Author Peters' circuit.—Editors.

TEST BENCH PUZZLER

To the Editors:

This is in reference to the solution to Bench Puzzler No. 1, which appeared in your July issue. The total resistance of the three 39,000-ohm resistors in parallel would be 13,000 ohms, as you have said. However, if one of the resistors should increase in value to 2 megohms, the way I figure it, the total resistance should then be 19,311 ohms rather than the 26,000 ohms mentioned.

PAUL LONGENECKER
Perrysburg, Ohio

To the Editors:

Somebody goofed in Test Bench Puzzler No. 1. But thanks for putting out the best mag in the business. Goofs like this really point out how infrequently they occur.

LEO J. QUINN, Capt. USAF
APO 12, New York, N. Y.

Many readers pointed out the error in the calculations shown. However, this takes nothing away from the validity of the puzzler, since this amount of increase in resistance would certainly produce the effects described.

Also note the author is correct in reporting no voltage change at point 7. As the complete receiver schematic shows, this point connects to a regulated source of 120 volts.—Editors.



Model No. 6506
6 transistors,
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5 1/4" long, 3 1/4" high,
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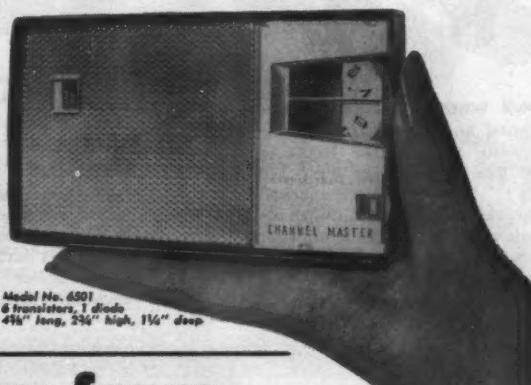
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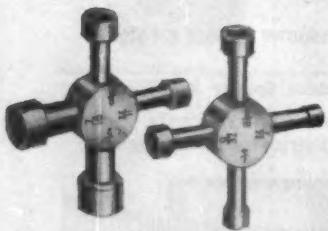
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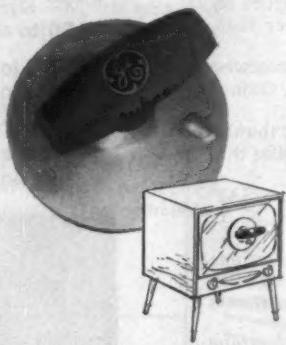
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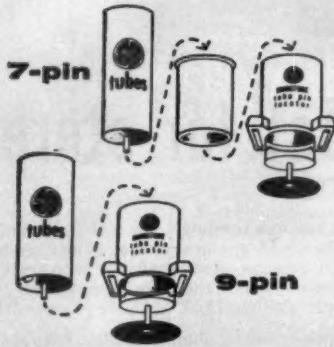
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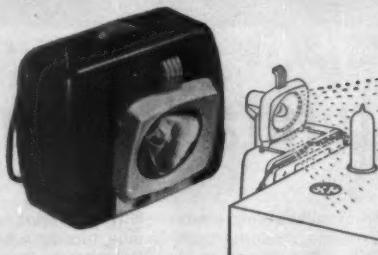
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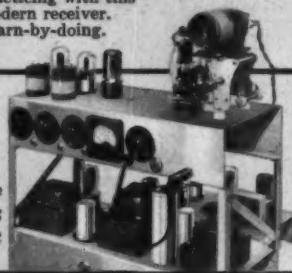


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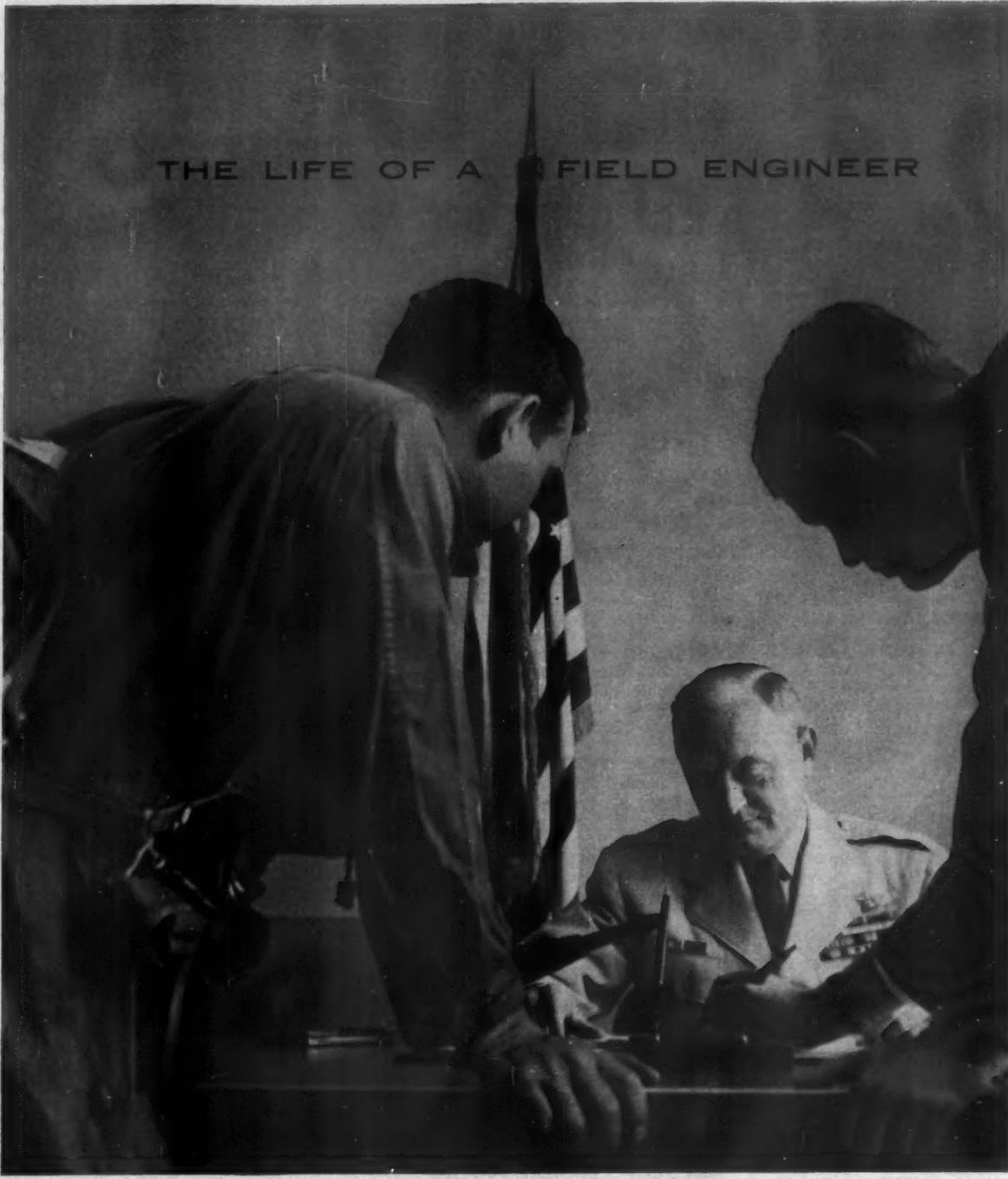
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Within the Industry

MATHIAS A. KLEIN, JR. has been elected vice-president of *Mathias Klein & Sons*, 7200 McCormick Road, Chicago 45, Illinois. In addition, the announcement was made by the president and treasurer of the company of the appointment of Richard T. Klein as secretary of the tool organization.

The hand-tool manufacturing company is in its 101st year and is still under family management.

The organization was founded in 1857 by Mathias Klein, grandfather of the current president of the firm.

ABRAHAM SCHWARTZMAN has been appointed executive secretary of the Institute of High Fidelity Manufacturers, Inc. He succeeds Edwin Cornfield, who resigned from this position.

Mr. Schwartzman has been in the magazine publishing business as editor and publisher for the past thirty years, most recently as publisher-editor of the "Brooklyn Queens Standard."

C. R. (RUSS) ROBERTSON has been appointed sales manager of *Weller Electric Corporation*, Easton, Pennsylvania.

Associated with the power tool manufacturing company for four years, Mr. Robertson was recently a regional sales manager, a position to which he was named in January, 1957.

He has had wide sales experience in the hardware, automotive, and industrial fields, with fifteen years of experience as a manufacturers' representative. In addition, he had been a manufacturer for more than ten years.

EMERSON RADIO AND PHONOGRAPH CORP. has purchased the consumer products division of *Allen B. Du Mont Laboratories, Inc.* The purchase consists of television receivers, phonographs, and high-fidelity and stereo instruments, together with the trade-

JOHN H. CASHMAN, founder and former president of *The Radio Craftsmen, Inc.*, died recently after a heart seizure.

Mr. Cashman, past chairman of the Association of Electronic Parts & Equipment Manufacturers and past director of the Electronic Parts

mark "Du Mont" for use in connection with home entertainment instruments.

After completion of production of the 1959 line of TV receivers and high-fidelity instruments, *Emerson* will acquire all tools, dies, molds, and other manufacturing equipment associated with these consumer products. The contract also provides for a royalty free license under *Du Mont* patents.

It is intended that the line will be merchandised separate and apart. This wholly owned subsidiary will be known as *Du Mont Television and Radio Corporation* and Benjamin Abrams will head it as president.

Mr. Abrams has announced the new organization will service present *Du Mont* distributors and dealers and will continue that firm's past policies.

REED VAIL BONTECOU has been appointed vice-president, marketing, for *CBS-Hytron*, the electron tube and semiconductor division of *Columbia Broadcasting System, Inc.*

He comes to the firm from *General Electric Company* where he was manager of marketing for the receiving tube department. During the fifteen years he was with the firm he rose from manager of standardizing, engineering department, to his recent position. He served in the sales department as market analyst, staff assistant to the manager, manager of market research, and manager of marketing research and product planning.

In 1953 he was made product manager and was elevated to manager of marketing a year later.

DAYSTROM INCORPORATED announces the formation of *DAYSTROM LIMITED OF ENGLAND*, a division of *Daystrom International*. The new subsidiary will manufacture a complete line of "Heath-kits" in a new 10,000-square-foot building to be constructed in the general vicinity of London. The line will be adapted to British requirements and all of the parts will be manufactured in

Show Corp., was one of the early manufacturers of short-wave and high-fidelity products, kits and components, and was active in industry trade circles for many years.

He formerly had been associated with *The Hallicrafters Company* in Chicago.

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the United Kingdom by an initial operating force of about 70. The kits will be sold exclusively via direct mail operation . . . **THOMPSON PRODUCTS, INC.** and its affiliate, **THE RAMO-WOOLRIDGE CORPORATION**, announce a merger of the two firms. Prior to this agreement, the parent firm owned approximately 57½% of the common stock of its affiliate . . . **LING ELECTRONICS, INC.** has acquired **UNITED ELECTRONICS COMPANY** of Newark, N. J.

DR. HARRY D. HUSKEY, Ph.D., is coordinating the activities of a newly formed advanced programming development group for the *Bendix Computer Division, Bendix Aviation Corporation*.

He is one of the foremost pioneers in the field of electronic computers and has served as consultant to the company since 1953. The new development group is located in Berkeley, California.

In addition, Dr. Huskey is an associate professor in electrical engineering and mathematics at the University of California at Berkeley.

ELECTRONICS INDUSTRIES ASSOCIATION has appointed members of the policy committee of its marketing data department for the fiscal year 1958-59.

They are: Chairman, Frank W. Mansfield, *Sylvania Electric Products Inc.*; Ben Adler, *Adler Electronics, Inc.*; Robert S. Bell, *Packard Bell Electronics Corp.*; Lester Bogen, *David Bogen Co., Inc.*; Bruce R. Carlson, *Sprague Electric Co.*; S. R. Curtis, *Stromberg Carlson Co.*; D. W. Gunn, *Sylvania Electric Products Inc.*; James E. Harrison, *Texas Instruments Inc.*; Charles N. Hoffman, *Warwick Manufacturing Corp.*; M. E. Lauer, *Sylvania Electric Products Inc.*; D. J. McCarty, *RCA*; W. S. Parsons, *Centralab, Div. of Globe-Union Inc.*; and Allen K. Shenk, *Erie Resistor Corp.*

HERBERT M. PONCHER has been elected vice-president in charge of *Newark Electric Company's* West Coast operations . . . **DR. ALFRED K. WRIGHT** and **PAUL SCHARINGHAUSEN** have been named vice-president in charge of engineering, and vice-president and general manager of the radio and TV tube division, respectively, of *Tung-Sol Electric Inc.* . . . **A. A. (AL) STROKA** has been promoted by *Ampex Corporation* to national sales manager for its instrumentation division . . . **DAVID SALTMAN** has been named manager of the printing division of *United Catalog Publishers, Inc.* . . . **WALTER F. HERMANN** has been elected vice-president in charge of operations of *Standard Coil Products Co. Inc.* . . . *Chicago Standard Transformer Corporation* has appointed **BENNETT COOK** advertising manager . . . **JOSEPH STARR** has been promoted to the position of sales manager, industrial division, *Pyramid Electric Com-*

(Continued on page 168)



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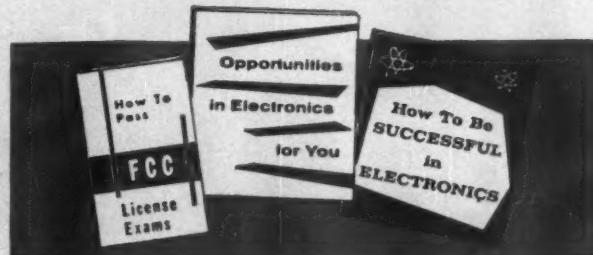
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Every part of every Collaro changer is precision-engineered to meet the rigid demands of Stereo

The new stereo records require a higher standard of performance from your record changer than do standard LP's because stereo cartridges are extra-sensitive to noise. That's why, in planning your stereo system, you begin with the Collaro. Every part of every Collaro changer is precision-engineered to meet the rigid quality demands of stereo.

The motor (see A above) is dynamically balanced, so rigidly mounted that wow and flutter specifications are superior to any changer.

The spindle assembly (B) reflects this precision quality in every part. The spindle itself is micro-polished for complete smoothness.

The sensitive velocity trip mechanism (part shown in C) has been designed so that the

changer can trip at extraordinarily light tracking pressures.

The exclusive Collaro transcription-type tone arm (D) with the new plug-in head (E) is designed to eliminate all resonances in the audio spectrum. The new four-pin head — the only high fidelity changer with this feature — provides the ultimate in noise-reduction circuitry.

There are three Collaro changers ranging in price from \$38.50 to \$49.50. No matter which you select, you're sure to start your system off right when you choose Collaro — the turntable that changes records.

For new Collaro catalog write to Dept. RT-10, Rockbar Corporation, Mamaroneck, N. Y.



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RADIO & TV NEWS



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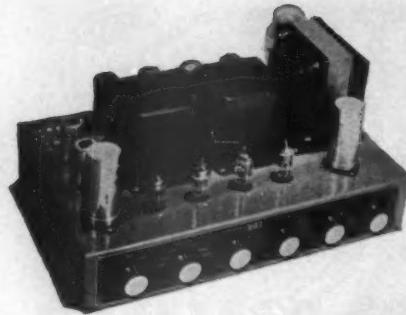
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Bell: Years Ahead...Years Ago.

This was the amplifier that started the swing to STEREO. The Bell Model 3D, introduced in May, 1953, it had dual inputs for radio, phono and tape.

"As a standard binaural amplifier, it would seem difficult to improve."

High Fidelity Magazine, November 1954

The experts were wrong. Today, nearly four years later, Bell introduces a complete new line of stereo components with more of the features considered most desirable in a Stereo Amplifier.*

Five years ago, Bell Sound Systems produced the very first 2-channel Stereo Amplifier on a single chassis. It was designed, primarily, to play Cook Binaural Records — the kind that required a two-headed tone arm to track two sets of grooves. Remember?



New features of the Bell Model 3030 Stereo Amplifier include Single-Knob Balance Control, Continuously Variable Loudness Control and Level Control with Built-In Channel Reverse for Stereo.

Quickly accepted as the standard of the industry, the 3D was acclaimed by the experts as "difficult to improve".

We thought so, too. But then, along came magnetic tape which immediately made stereo playback and recording possible. Taking advantage of the quality reproduction of tape, Bell modified its 3D — and added a Tape Head Input.

That was in 1956. A year destined to make hi-fi history; Bell, set to introduce the "sleek, slim silhouette", announced the first major breakthrough in high fidelity styling.

"Impossible", said our friends when Bell revealed plans to re-design its 2-channel Stereo Amplifier, early this year with the same long, low look, only 4" high, as the rest of its monaural line.

*See Page 32, Hi Fi and Music Review, August, 1958.



Professional Stereo Recording System, made by Bell, includes the Model T-213 Tape Transport with two RP-120 Record Playback Pre-Amplifiers in a Portable Carrying Case. Tape Transport with new Auto-Stop Switch, and Add-On electronic components are available separately for your own custom installation. Only Bell has these outstanding components to let you make your own professional stereo recordings on tape for less than \$300.

The experts were wrong. Sixty days ago, Bell again set the standard for all others to follow with the introduction of the new Model 3030, a 2-channel, 30 watt stereo amplifier with built-in pre-amps. With more features to play the new "single-groove" stereo records and reproduce stereo radio broadcasts, the 3030 also made possible top-quality tape playback (direct from tape heads or tape pre-amps).

For this purpose, Bell last year introduced a new Tape Transport in 4 basic models; the only one of its kind to RECORD STEREO, with its own specially designed Add-On pre-amplifiers for playback and recording.

This is a professional-type machine, with three heavy-duty 4-pole motors and a frequency response of 25-12,000 cps \pm 2db. Used for stereo recording, the Bell Tape Transport effectively copies stereo tapes and records and captures stereo broadcasts off-the-air. In one year, this component has won unanimous consumer acceptance to gain unchallenged leadership in its field.

With the new Bell 3030 Stereo Amplifier, the Bell Tape Transport represents a complete stereo system that will not become obsolete in the future; Units now being made have provision for a 4-track head to play 4-channel tapes when they become available.

Recently, Bell made available a low-cost Stereo Amplifier for the "budget-buyer". Known as the Pacemaker, this 2-channel, 20 watt stereo amplifier is still another product of Bell Stereo "know-how", with an outstanding array of features for its low cost.

Today, there are more Bell Stereo Amplifiers in use than all others combined. But progress continues.

To maintain its position as the only manufacturer of a complete line of Stereo components, Bell is getting set to produce even



Pacemaker Stereo, shown here, is a low-cost 2-channel 20 watt amplifier. Known as the Model 2221, this Bell product has inputs provided for stereo records, tuner and tape. Plays monaural programs at the flick of a switch.

more big-power stereo amplifiers and stereo tuners. When these are announced, we promise they will be ready to deliver to you. This is our responsibility of leadership.

In the meantime, as a reader interested in the progress of Bell Stereo, we suggest you obtain a copy of the new Bell High Fidelity Handbook. This 24-page book contains photographs and specs. of the complete line of Bell components. Write us for your free copy.

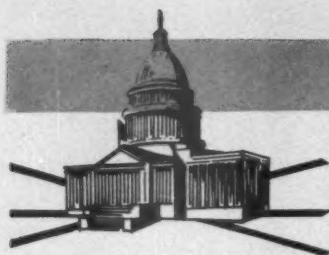
Bell Sound Systems, Inc., 555 Marion Road, Columbus, Ohio

A division of Thompson Products, Inc.





A Complete Stereo System: Shown here is a typical custom installation of the Bell Model 3030 Stereo Amplifier with a Bell Tape Transport. With these components for your Stereo system, you can start to enjoy the finest quality sound reproduction on tape. Amplifier has inputs to play monaural and Stereo discs with your present record player.



Latest Information

on the Electronic Industry

Spot News

By RADIO & TV NEWS'
WASHINGTON EDITOR

PAY-TV MOTHBALLED UNTIL '59—Pay-TV is once again in storage; this time until the middle of next year. Postponed action was dictated by a request from Congressman Oren Harris, chairman of the House Interstate and Foreign Commerce Committee, who noted that the House will probably be asked to vote next year on a resolution blocking the FCC from approving any toll-television applications, unless Congress enacts a new law saying that the Commission has such authority. According to the FCC, they now have such authority.

SOLAR-POWERED WORLD-WIDE SATELLITE REPEATERS URGED—Solar-powered wide-band satellite repeaters, orbiting at altitudes of about 22,000 miles in the equatorial plane, could provide line-of-sight radio-relaying facilities for thousands of radio and TV channels, according to Burton F. Miller of Ramo-Wooldridge. In a paper delivered before the Institute of Aeronautical Sciences, it was noted that such satellites could provide world-wide communications not only on microwaves, but on lower frequencies; transmission of signals over ranges of 8000 to 10,000 miles would, it was said, be little more difficult than present transmission of such signals over ranges of less than 75 miles.

\$60-MILLION RADIO RESEARCH OBSERVATORY PLANNED BY NAVY—A \$60-million radio astronomy station has been blueprinted for a 1500-acre facility in the mountains of West Virginia near Sugar Grove. The project will culminate 11 years of intensive research by the Naval Research Lab in Washington, D.C.

CITIZENS RADIO SERVICE RULES REVISED—The Commission has finalized rule making and issued completely revised details governing the Citizens Radio Service. The new order re-allocates frequencies in the 26.96-27.23 mc. band from the amateur radio service and makes them available to Citizens Radio; limits the maximum permissible plate input d.c. power in the 26.96-27.23 mc. band to 5 watts; establishes a new "Class D" station; provides for type-acceptance rather than type-approval of equipment to be used by "Class A" stations; retains "Class B" stations in substantially their present form, but reduces the maximum authorized power of such stations from 10 to 5 watts.

AERONAUTICAL SEARCH AND RESCUE STATIONS AUTHORIZED—A new class of station—Aeronautical Search and Rescue Mobile Station—is now on record providing for the use of 121.6 mc. by stations aboard aircraft.

ELECTRONIC BLOODSPOT DETECTOR FOR EGGS—An electronic detector is now being used to discover and reject eggs containing bloodspots. The technique is said to be twice as effective as the old "candling" method. The new unit was developed by the U.S. Department of Agriculture.

CO-CHANNEL TV REPEATER TO TEST U.H.F. SERVICE AREA SHADOW—To help determine whether a co-channel TV repeater station can fill in a shadow in a u.h.f. service area, the FCC has granted a one-year experimental license to Binghamton Press Co. to operate such a station in connection with its regular TV station, WINR-TV, channel 40. A 10-watt operation with vertically polarized antenna is to be used.

TV-TUBE NIGHT-VISION DEVICE USING LIGHT FROM STARS DEVELOPED—A night-vision device which gathers reflected starlight or diffused light from sky-glow falling upon the objective and then intensifies or amplifies the light sufficiently to present a distinguishable image has been developed by the U.S. Army Engineering Research and Development Labs at Fort Belvoir, Virginia and RCA. Known as the "Cascaded Photosensitive Image Intensifier," it employs cascaded image tubes—two tubes in series—operating through an optical system which focuses light reflected from objects in the field. First tube acts as a preamp for the second. The tubes are powered by a six-volt battery in a transformer-transistor circuit. -50-

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October, 1958

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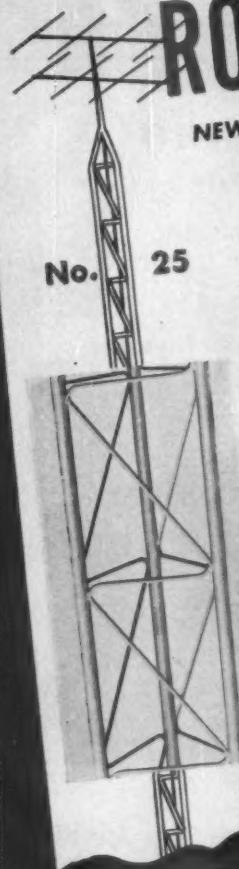
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These amazing results are achieved through using heavier-duty side rail tubing, quality steel that is of the highest grade and a new "zig-zag" cross bracing design.

The strength of this tower allows it to be self-supporting under most condi-

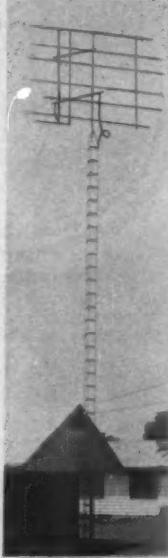
tions to 50' and under guyed conditions up to 150'. The tower has been built to fit a tremendously wide range of needs in communications, amateur use and as a heavy-duty TV tower.

FLASH! The "RohnKote" enameling plant is in operation and ROHN products are available not only in **HOT-DIPPED GALVANIZING** but also in a specially developed 6-step enameling process known as "RohnKote".

NOW! 10 Different Lines of ROHN TOWERS, Including:

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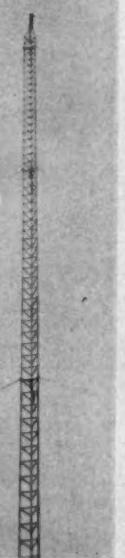
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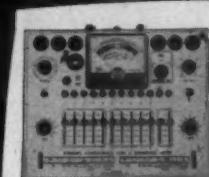
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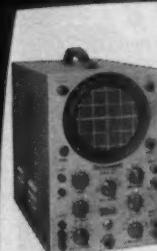
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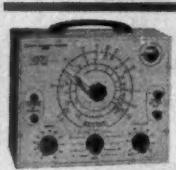
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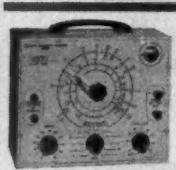
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RADIO & TV NEWS



Model M3D pickup



Electro-Voice 26DST



Columbia Model SC-1



Electro-Sonic ESL-C100



Ductone Model GPS 80-1D



Weathers Model SW 10D



Sonotone Model ST-4D



Model Stereo-OV pickup

PICKUP CARTRIDGES FOR STEREO

*You'll need a new cartridge to play stereo records.
Here's latest information on what is available now.*

By NORMAN H. CROWHURST

A MODERN stereo pickup—even a low-priced one—is made to standards comparable to a watchmaker's. Aside from the very unlikely conversion kit, you will need a *stereo cartridge* to play the new stereo discs.

Where the monaural pickup had only to transcribe lateral or sideways vibrations, ignoring any vertical movement that might appear, the stereo pickup stylus have to be capable of moving freely up and down as well as sideways, to transcribe vibration that is basically in two 45° angular movements. Not only must it move freely in all directions to permit following of the complicated stereo groove, it must separate the components of movement in the two 45° directions belonging to each channel.

This may be comparatively easy to achieve at some frequencies; but a good pickup must maintain this independence of movement at *all audio frequencies*. At low and middle frequencies it is relatively easy; but at the highest frequencies it gets difficult. Then, of course, a stereo pickup has to give two separate outputs, one for each channel. The electrical outputs have to be kept separate as well.

There is no doubt that the design of a good stereo pickup poses more problems than the design of a monaural one. Different approaches can be and are used. The pickup can use moving iron, moving magnet, moving coil, crystal, or ceramic elements and the relative merits of these types are not *basically* changed by whether one or two channels are used.

The design of a stereo cartridge demands a fresh approach. You cannot just tie two monaural mechanisms together to one stylus (although some have tried it) and get a good stereo

cartridge. As a result of the genius put into their design, a completely different pattern of relative merit among different types may emerge for stereo.

It doesn't matter which type you inquire about, you will get conflicting opinions—right now. Some comments you will hear are based on the conviction that "that is the wrong way to make a stereo pickup." Each manufacturer with any reputation at all (by which we mean those who design their own, rather than copying what someone else has done) has evaluated the problems of making a stereo pickup: which kind of transducer to use, how to couple two of them to one stylus (the kind of mechanical linkage to employ), how to avoid cross-modulation and other troubles, and so on.

He has naturally settled for the one that seemed to show best prospects from his evaluation. One will argue that the best approach is to get the transducers coupled right to the stylus or its arm, with little or no mechanical linkage. Another feels it is best to separate the two modes of movement right at the stylus and use separate linkages to each element. Each way has its problems that individual designers evaluate and overcome to some degree.

Among the early stereo recordings, some have practically no "highs" above about 8000 cycles, while others do have highs beyond this point, but with distortion. Very few of the early discs have extended highs without some distortion.

This can be misleading in choosing pickups, unless you are aware of it. Records in which the highs have been rolled off will probably sound better on a pickup that goes out farther, other things being equal; but records with

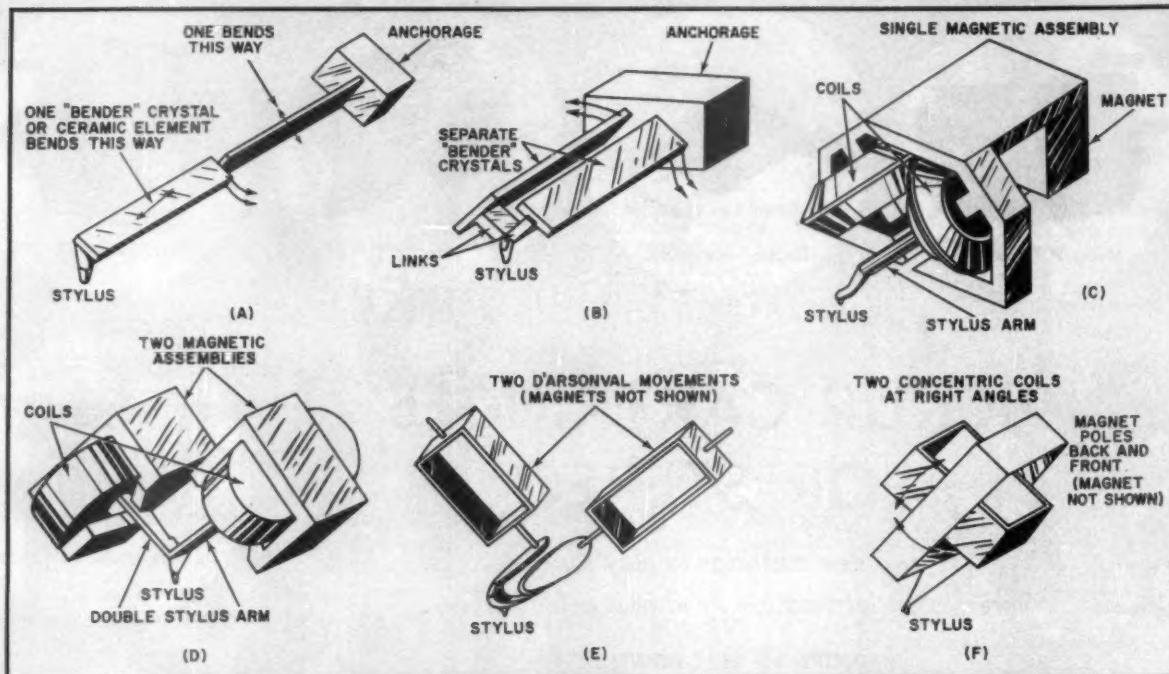


Fig. 1. Several possible ways of constructing stereo pickups, showing basic differences between transducer arrangements and linkages. Possible variations are, of course, virtually infinite. (A) and (B) are two possible piezo-electric element structures, (C) and (D) show moving-iron, fixed-coil arrangements, while (E) and (F) are two types of moving-coil units.

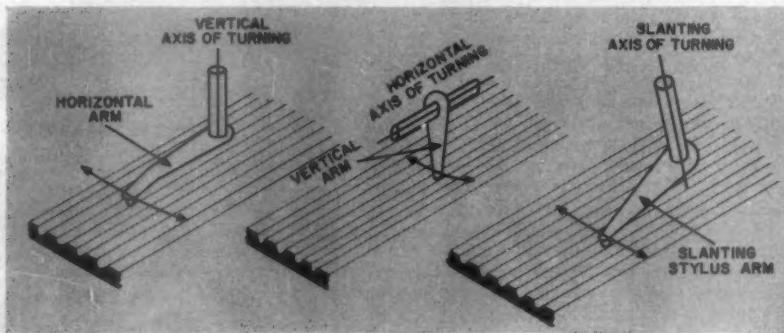
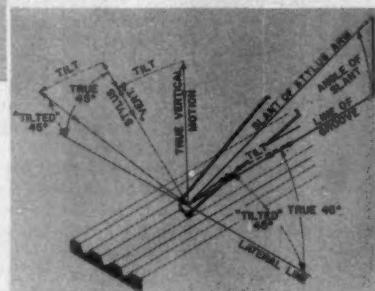


Fig. 2. With lateral recordings, the slant of the stylus arm is not too important. The arm could be horizontal, vertical, or at an in-between angle.

Fig. 3. Slanting the line of the stylus arm in a stereo cartridge invalidates the 45-degree angles, particularly the vertical components, relative to the surface of the record. But no distortion results if cutter and pickup stylus arms both use same angle.



distorted highs may sound better on a pickup with restricted high-frequency response.

We can be reasonably certain that records will improve; later editions will go on out-clean. Failure at the high end (above 8000 cycles) however, may not be such a bad thing in stereo because very extended high-frequency response is far less necessary to a sense of realism in stereo than in monaural. Failure to reproduce the extreme highs would be better than reproducing them with some distortion.

One thing which should be noted when choosing a pickup is the "slant" of the stylus arm (Fig. 3). In monaural records, using laterally recorded grooves, this is not important. A stylus arm could come down vertically, or it could come forward horizontally, or it could have some in-between angle (Fig. 2). But when the records include a vertical component, which 45-45's do, the angle becomes important.

Ideally, both the recording stylus and

pickup stylus arm should be horizontal, but this is not feasible. The pivot would have to be down in the record groove! The next best thing would be to have both cutter and pickup stylus arms at the same angle. Unfortunately no standard has yet been established, but it would seem a safe bet that the standard angle for cutters will be somewhere between 15° and 30°.

It would be difficult (if not impossible) to make a pickup where this angle is less than 15° but the upper limit should certainly not exceed 30°. Until a cutter standard is established, one angle (within a reasonable range) is as good as another. When a difference exists between the angle at which the record was cut and the pickup angle, a little distortion will occur, but not too much, if the difference is small.

Tracking force—the weight with which the stylus bears down in the groove—is important. Because of the smaller stylus used for stereo, the lightest possible force is desirable to

prevent undue record wear. For the same reason a diamond stylus is recommended for extended playback. You may save quite a little by getting sapphire, but this may prove to be a false economy. Most available cartridges can be obtained with diamond stylus.

Tracking force must be adequate. Don't be led into using too little in your desire to keep it down. This, too, can cause wear and will produce considerable distortion when playing. Most stereo pickups produced thus far need at least 3 to 7 grams tracking force.

Some pickups have three terminals,
(Continued on page 38)

STEREOPHONIC CARTRIDGE DIRECTORY

MAKER	MODEL NO.	TYPE*	TYPE**	STYLUS RADIUS (in mils)			NO.***	TRACKING FORCE (grams)	LOAD FLAT RESP. (ohms)	NO. OUTPUT LEADS	NET PRICE
ASTATIC	13-TB	Cer.	Sa.-Sa.	.7 & 3	2	5.7	2 meg. or more	4	\$ 7.95		
	13-TB	Cer.	D-Sa.	.7 & 3	2	5.7	2 meg. or more	4	\$ 20.50		
	13-TB	Cer.	Sa.-Sa.	.7 & .7	2 ¹	5.7	2 meg. or more	4	\$ 7.95		
AUDIOGERSH	Stereowin 200	Mag.	D	.7	1	4-6	37K	3	\$ 59.50		
CBS-HYTRON	SC-1	Cer.	D	.8	1 ¹	5.7	1.2 meg.	3	\$ 21.75		
DUOTONE	GPS80-1D	Cry.	D	.7	1	2.6	2 meg.	3	\$ 31.25		
	GPS80-1S	Cry.	Sa.	.7	1	2.6	2 meg.	3	\$ 20.00		
ELECTRO-SONIC	ESL-C100	Mag.	D	.7	1	2.4	Not Critical	3	\$ 69.95		
	ESL-P100	Mag.	D	.7	1	2.4	Not Critical	3	\$ 79.95		
ELECTRO-VOICE	21D	Cer.	D	.7	1	3.6	3 meg. or more	3	\$ 19.50		
	21S	Cer.	Sa.	.7	1	3.6	3 meg. or more	3	\$ 9.90		
	26DST	Cer.	D-Sa.	.7 & 3	2	3.6	3 meg. or more	3	\$ 22.50		
	26ST	Cer.	Sa.-Sa.	.7 & 3	2	3.6	3 meg. or more	3	\$ 12.90		
ERIE RESISTOR	St-ERIE-O	Cer.	?	?	1	6-8	3 meg.	3	?		
FAIRCHILD	232	Mag.	D	.7	1	2-4	5K or more	4	\$ 49.50		
GENERAL ELECTRIC	GC-5	Mag.	D	.5	1	2.4	100K	4	\$ 26.95		
	GC-7	Mag.	D	.7	1	3.5-7	100K	4	\$ 23.95		
	CL-7	Mag.	Sa.	.7	1	3.5-7	100K	4	\$ 16.95		
GRADO	Stereo	Mag.	D	.7	1	2	5K or more	4	\$ 49.50		
HEATH	SF	Mag.	D	.6	1	2-4	50K	4	?		
PICKERING	371D	Mag.	D	.7	1	4-6	27K-47K	4	\$ 29.85		
RONETTE	BF-40	Cry.	Sa.	.75	1	4-6	500K	3	\$ 20.00		
	BF-40-4	Cry.	Sa.	.75	1	4-6	500K	4	\$ 20.00		
	Stereo-OV	Cry.	Sa.-Sa.	.75 & 2.5	2	4-6	500K	4	\$ 21.45		
SCOTT, H. H. & LONDON RECORDS	1000	Mag.	D	.5	1	3.5	50K	4	\$ 89.95†		
	M3D	Mag.	D	.7	1	3-6	50K	4	\$ 45.00		
SONOTONE	8T-4S	Cer.	Sa.-Sa.	.7 & 3	2	5.7	1 to 5 meg.	4	\$ 14.50		
	8T-4SD	Cer.	D-Sa.	.7 & 3	2	5.7	1 to 5 meg.	4	\$ 24.50		
	8T-4D	Cer.	D-D	.7 & 3	2	5.7	1 to 5 meg.	4	\$ 34.50		
TANNOY	Vari-Twin	Mag.	D	.7	1	3-4	50K	4	\$ 37.00		
WEATHERS	SW10D	FM	D	.7	1	1	3 meg.	3	\$ 114.50		
	SW50S	FM	Sa.	.7	1	1	3 meg.	3	\$ 99.50		
	C501D	Cer.	D	.7	1	2.5-3	3 meg.	5	\$ 17.50		
	C501S	Cer.	Sa.	.7	1	2.5-3	3 meg.	5	\$ 9.75		
WEBSTER ELECTRIC	SC-1	Cer.	Sa.	.5	1	5.7	1 meg.	3	?		
	SC-1D	Cer.	D	.5	1	5.7	1 meg.	3	\$ 24.50		
	SC-TD	Cer.	D-Sa.	.5 & 3	2	5.7	1 meg.	4	?		

The directory given above lists all the stereo cartridges that are available as we go to press along with some of their important specifications. Other characteristics, often given by some cartridge manufacturers, were not included because of the lack of standardized testing procedures that would permit an accurate comparison to be made. For example, the amount of output voltage from a cartridge depends on the particular test record used, the recorded velocity employed, and the load on the cartridge. In general, crystal and ceramic cartridges have high outputs on the order of .25 to 1 volt per channel. Magnetic cartridges, on the other hand, have outputs ranging from 1 to 25 millivolts, with the moving-coil types at the low end of this range. Frequency response of all types is given

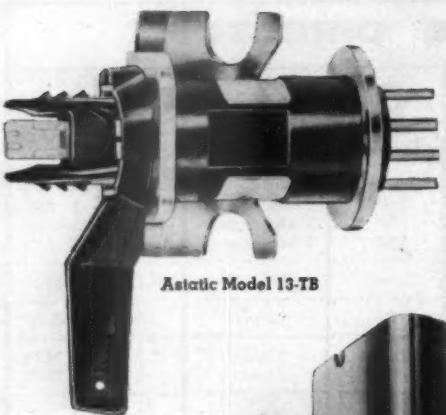
as a nominal figure ranging from 10 to 30 cps at the low end through 12,000 to 30,000 cps at the high end. Channel-to-channel separation of most of the units shown is about 20 db, with a few claiming as much as 25 or more db separation. Lateral compliance varies from slightly under 2×10^{-6} cm./dyne to as high as 6 or 8×10^{-6} cm./dyne, with most of the cartridges claiming compliances of about 2×10^{-6} cm./dyne. Vertical compliance of most units is given by the manufacturers as the same as the lateral figures, although in one or two cases, a slightly lower vertical compliance is specified. If and when industry-wide standards are set up for determining some of these figures, a more intelligent comparison will be able to be made among the various units that are available.

NOTES:

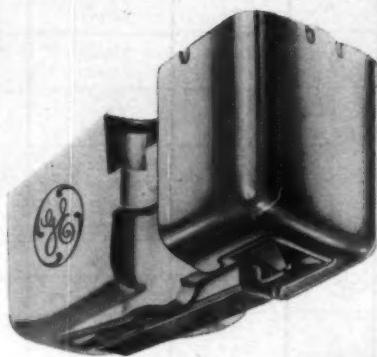
*Mag. = magnetic; Cer. = ceramic; Cry. = crystal; FM = FM, capacitance; **D = diamond stylus; Sa. = sapphire stylus

***1 = single stylus for 16 2/3, 33 1/3, and 45 rpm. 2 = dual stylus for 16 2/3, 33 1/3, and 45 rpm; and for 78 rpm monaural. 2¹ = both stylus the same for microgroove records only. 1¹ = recommended by manufacturer for use with both 78's and microgroove discs.

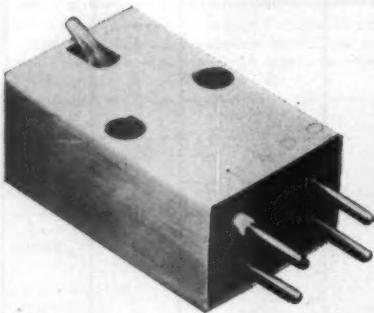
†Includes special arm



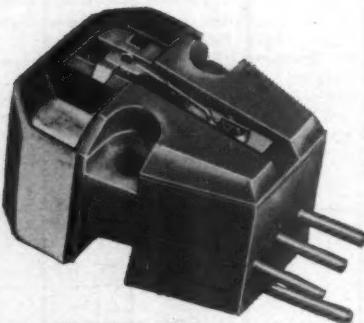
Astatic Model 13-TB



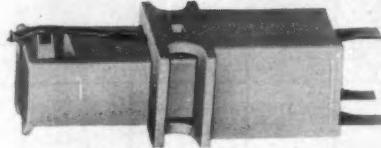
General Electric
Model GC-5 cartridge



Grado Stereo cartridge



Tannoy Vari-Twin pickup



Webster Model SC-1D



Scott-London Model 1000



Pickering Model 371

Audiogear Stereotwin 200



Fairchild Model 232
stereo cartridge

a common and two "hot" leads, while some have four, providing completely separate connections to each element. In "standard" phasing, the cartridge will usually be made available as a replacement item, the three-terminal job will have a common and two "plus" hot leads. If each amplifier has the same number of stages (which is usual) and the loudspeakers are identically connected, the system phasing will come out right this way.

But it is not impossible that some playback systems will be designed where the reverse connection, using a common with one "plus" and one "minus" hot lead, will be required; in which case a three-terminal pickup with opposite phasing may be necessary.

A four-terminal pickup will be adaptable to either kind of system, although even with a three-terminal cartridge, phase reversal at the speaker itself is possible. The four-terminal pickup will enable the ground leads of the two channels to be separated, which is vital for inexpensive systems using transformerless (a.c.-d.c.) amplifiers.

Stereo cartridges are appearing all over the place now. The listing given on page 37 is as complete as we could make it at press time. The rapidity with which new cartridges are appearing, along with the factors which make early comparisons dubious, mean it is impossible to advise which is the "best" kind.

Fig. 1 shows *some* of the possibilities, using crystal (or ceramic) or magnetic construction. In each case there is the possibility of a "single" or "double" moving assembly attached to the stylus. Each can probably be re-arranged in an almost endless variety of ways to make what might appear here to be a complicated or clumsy construction into a relatively simple one.

It should be stressed that the units diagrammed in Fig. 1 do not represent anywhere near all the *possible* variations—not even all the arrangements that have been used thus far. But it will be gathered from this that the design of pickup cartridges for stereo has opened a new field of exploration for genius. Some of the current designs are ingenious but there are probably many new ideas still to come.

Remember that the simple constructions are best. Complicated, clumsy constructions are apt to produce resonances and distortion. The moving parts need to be both rugged and very light, with the precision construction usually associated with delicate watch parts. At first, such a combination sounds impossible but already several designs have achieved the "impossible"—or come close to it!

What we can say is that each type and method is only as good as the individual model which results. A well-made pickup of almost any type may outperform others not as well designed and carelessly assembled. The ultimate test of any cartridge (and this goes for all the links in the audio chain) is how well it satisfies *your ears*!



TELECOPTER



-A FLYING TV STATION

Close-up view of the flying TV remote unit described below.

World's first commercial airborne television remote unit now being used by Los Angeles TV broadcaster.

COMBINING the immediacy of television with the maneuverability and versatility of a helicopter is the Telecopter, the world's first commercial airborne TV remote unit. The remote is being used by KTLA, an independent Los Angeles television station owned by *Paramount Pictures*. The electronics in the helicopter was a 6-month project of the station's Chief Engineer, John Silva. Total weight had to be restricted to less than 400 pounds.

The entire cost of equipping and developing Telecopter is estimated at \$40,000 plus another \$42,000 for the *Bell* helicopter that is used.

Silva designed two boxes which ride on the helicopter's skids to carry much of the equipment. The camera, monitor, and audio and video controls were placed in the "bubble." The entire equipment includes transmitters for both audio and video, the monitor, a communications system, a power supply, and a *G-E* vidicon camera that is equipped with a *Zoomar* lens. The pilot does double duty as observer. Completed, it is, in effect, a miniature airborne television station.

In addition to the weight, the second major problem was to equip the copter with a suitable antenna so that a signal could be transmitted directly and easily to Mt. Wilson, headquarters for the station's transmitters, while the aircraft was flying. It is important to

be able to get a good picture from the plane even at the farthest points of the 40-mile range of the Los Angeles Basin. The solution to the problem was to use an antenna in the copter that would transmit equally in all directions horizontally and be directional vertically. Signals from this antenna could then be picked up by a receiving "dish" antenna located at Mt. Wilson. The mobile antenna finally chosen was a scaled-down version of a *G-E* helical transmitting antenna. Since the microwave frequency of 2000 mc. is used, it was possible to construct the antenna small enough to be carried conveniently. Final dimensions are a mere 4 inches in diameter and 3 feet in length.

A final problem involved overcoming the intense vibration that exists in the copter. Special shock mounts and baffling were used to prevent the equipment from being jarred excessively.

-30-



John Silva, KTLA Chief Engineer and designer of the Telecopter, explains the operation of the airborne antenna that is used in the helicopter to local law enforcement officers at the Police Academy.

The flying remote television station → is shown here coming in for a landing in the KTLA parking lot during the first on-the-air demonstration of the Telecopter.



stereo... tape or disc?

By C. J. LeBEL
Vice-President
Audio Devices, Inc.



Our author is an authority in the field of sound recording. Prior to his present position, he was Chief Engineer for Audio Devices, Inc. from 1938 to 1942. After that he was Director of Research for the Malco Co., dealing with hearing test equipment and hearing aids. He has also been a consultant on recording problems. Mr. LeBel is the holder of nine patents in the audio field and is very active in standards work. As a matter of fact, relatively little U. S. standardization work in the non-film sound recording field has been done without his annoyance, presence, membership, or chairmanship, in the last 18 years. He is quite active in various societies, being Secretary and a Fellow of the Audio Engineering Society. Mr. LeBel is the author of the book "Fundamentals of Magnetic Recording" as well as "How to Make Good Tape Recordings."

Clear and authoritative summary of the characteristics of the various stereo methods. Our author, who has no axe to grind, feels there will be a market for all methods.

THE last few months have seen the beginning of really widespread interest in stereophonic home reproduction touched off by the Frayne and Davis paper on stereo discs at the last Audio Engineering Society Convention. Since then interest has risen daily, coupled with increasing puzzlement as to method.

The interest is easy to explain, for the three-dimensional feeling conveyed by stereo means more natural and so more pleasant listening. Three-dimensional listening, after more than thirty years, has come out of the laboratory and into the home. We presently are offered three ways to reproduce stereo, and that is where the puzzlement arises: which will best suit your individual requirements? This article will try to shed some light on the subject.

The discussion of the question by well-meaning, but poorly informed, enthusiasts has produced far more heat than light, because they persist in seeing the problem in black and white, rather than in its many true shades of gray. The problem is not so simple that a black and white answer is possible, particularly as to tape versus disc. After twenty years of experience in the manufacture of recording materials, our firm still finds importance in both tape and disc. The duality of interest keeps us from bandying clichés about, and guarantees that this article will not satisfy the black and white school of thinking.

Three Recording Methods

In disc, the 45-45 stereo recording method has been standardized worldwide by the disc industry. The sound in the left-hand channel is, in effect, recorded on one side wall of the record groove, and the sound in the other channel is recorded on the other side wall. The over-all result is of the utmost complexity, and the recording technique has become correspondingly sophisticated—which bothers the recordist but not the user.

In tape, we have two-track 7½ ips on reels and four-track (bi-directional) 3½ ips in magazines. Thus there are basically three stereo methods that are available to the user.

45-45 Disc

Disc is potentially the most economical, for it is cheaper to press in one motion from a biscuit of plastic than to duplicate tape foot by foot. On the other hand, a stereo disc

is not as inexpensive to make as is a monaural disc, for there are complications. The recording equipment is more costly and more complex to handle, and this is inherent. More costly is the care needed in processing, for a stereo disc has to be much more free from ticks and pops. A left-handed tick or a right-handed pop is very disconcerting—it destroys the illusion. Tick- and pop-free records can and have been made, but doing this consistently in production inevitably costs more. Worse yet, how many of us store our discs so that they are completely or even adequately protected from dust?

Disc signal-to-noise ratio is good, but not equal to that of the monaural disc because of the recording level reduction which is necessary to minimize distortion. At the moment it is claimed that stereo recording level must be 3 db lower, but a brief listening to test pressings will quickly convince one that the reduction will ultimately be nearer to 5 or 6 db, as compared to a monaural disc. This means a 5 to 6 db poorer signal-to-noise ratio than for the normal monaural disc, or a net result on the order of 48 or 49 db.

The less technical reader can think of "signal-to-noise ratio" as virtually synonymous with the less exactly defined "dynamic range." The psycho-acousticians might quarrel with this statement, but only slightly, hence we will ignore them.

Discs offer the most compact storage means.

Frequency range is potentially good, equal to that of monaural discs: 30 to 15,000 cps.

Discs offer the great convenience provided by record changers. However, vertical rumble in many low-cost turntables and changers is presently high, and it is impossible to forecast how quickly improved designs will get into production.

Finally and worst of all is the problem of channel separation in the pickup. Some pickups offer as little as 6 db separation, many run 15 to 20 db. To achieve a consistent 25 db requires the best pickups, at the highest cost. The average is not as good as that obtainable with the twin-track tape.

Two-Track 7½ ips Tape

The two-track tape method offers the best channel separation, 25 db in the most inexpensive systems and 35-50 db in the best.

Signal-to-noise ratio is good, perhaps 50 db, and to the ear quite comparable to that of stereo disc. Most important, the noise does not increase with use, contrary to the increasing wear of the disc, and ticks and pops do not exist. On the other hand, one pass over a magnetized head, and the tape hiss increases substantially. This is of some importance with combined home recorder-reproducers, for how many home listeners possess a head demagnetizer—or use it often enough?

Print-through from one layer to another increases steadily.

ily with time of storage, and after a while may be as bad as or worse than background noise. This "echo" could be minimized by the use of low-print material such as "Master Audiotaape," but we have no assurance that any recorded tapes will utilize such a superior but higher cost material.

Some object to having to thread the tape through the recorder and onto the take-up reel. Recorders are much easier to thread now, and recent reel designs show equal improvement. In fact, one design can be threaded by a hand which is all thumbs.

Finally, this is the highest cost method.

Bi-Directional Twin-Track 3 1/4 ips Tape

The four-track (bi-directional) is the lowest cost tape method, undoubtedly competitive with disc. The magazine container for the tape provides easy loading, and the tape gives immunity from ticks and pops.

On the other hand, in technical matters one never gets something for nothing, and the lower cost is purchased at the expense of degeneration of performance.

The first loss is in signal-to-noise ratio. With about half the track width and half the tape speed, we lose a total of 6 db. This is inherent, and irretrievable. The maximum signal-to-noise ratio is thus likely to be under 44 db—which is usable but not of the best.

Secondly, high-frequency response is retained at the lower speed by the use of an improved head with a tenth-mil gap. The improvement is genuine. However, the response so gained will be very sensitive to dirt on the head, and how many home users use head cleaning fluid regularly?

Thirdly, the narrower tracks used will make the high-frequency response vulnerable to many things. Thus, a tape which has been stretched by machine misbehavior will have erratically varying highs. A speck of dust on the tape will make the highs disappear for a minute fraction of a second with narrow recording tracks, while the wider twin-track would be practically unaffected. The outer edge of each outside track rides on a head, so that a tape edge which has been curled over by faulty reproducer guiding will not contact the head properly; the high-frequency response of the narrow track will be impaired. The narrower the recorded track, the slower the tape speed, and the higher the frequency, the worse these effects become.

Fourthly, there will probably be slightly impaired channel separation due to the proximity of the reverse-direction track, although the effect will be small (because no head contacts the track in question).

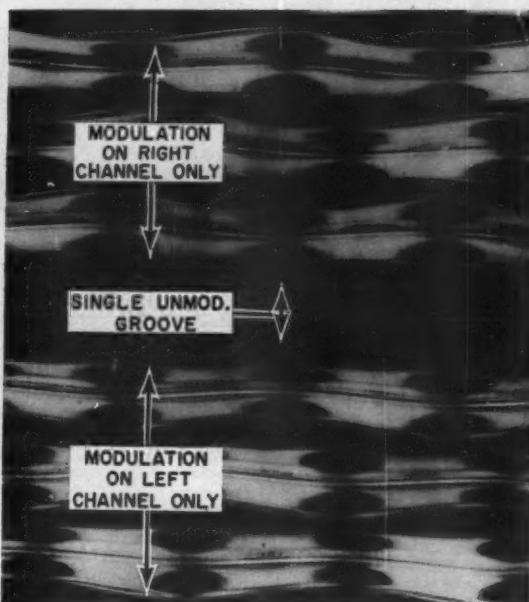
Finally, there will be the matter of turning the magazine over by hand after the tape has been played in one direction, for only the more costly machines will have automatic reel reversal.

Since we are using tape, previous remarks about the effect of magnetized heads on hiss, the need for low print-through tape, the normal lack of wear, and the absence of ticks and pops all apply equally.

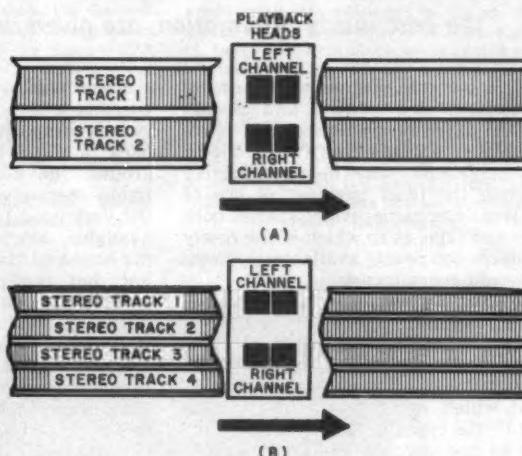
Conclusions

Even a brief listening to stereo will prove that the gain in quality, since the phonograph recordists took over from the recorder manufacturers, has been enormous. It is not easy to forecast the outcome of the three-way competition, since 4-track tape is not yet in commercial use, and stereo disc has been in full-scale production for only a short while, as this article is being written. However, we will hazard a guess or two and then wait for the storm to break about our ears:

1. The disc will enjoy mass acceptance, due to low cost and the convenience of the record changer.
2. The 4-track tape will enjoy good acceptance, due to low cost and the freedom from ticks and pops.
3. The serious listener, truly interested in quality, will have a great deal of difficulty in choosing between the convenience of disc and the quality of two-track tape. He will end up by owning both.
4. In many cases, due to lower cost, the disc will serve as an introduction to stereo, to be followed later by the more expensive two-track stereo tape.

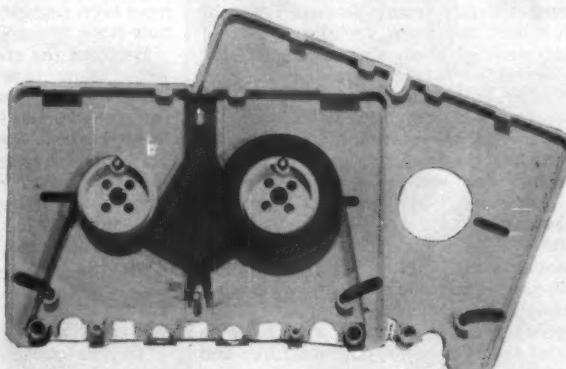


Photomicrograph of record grooves on a 45-45 stereo disc.

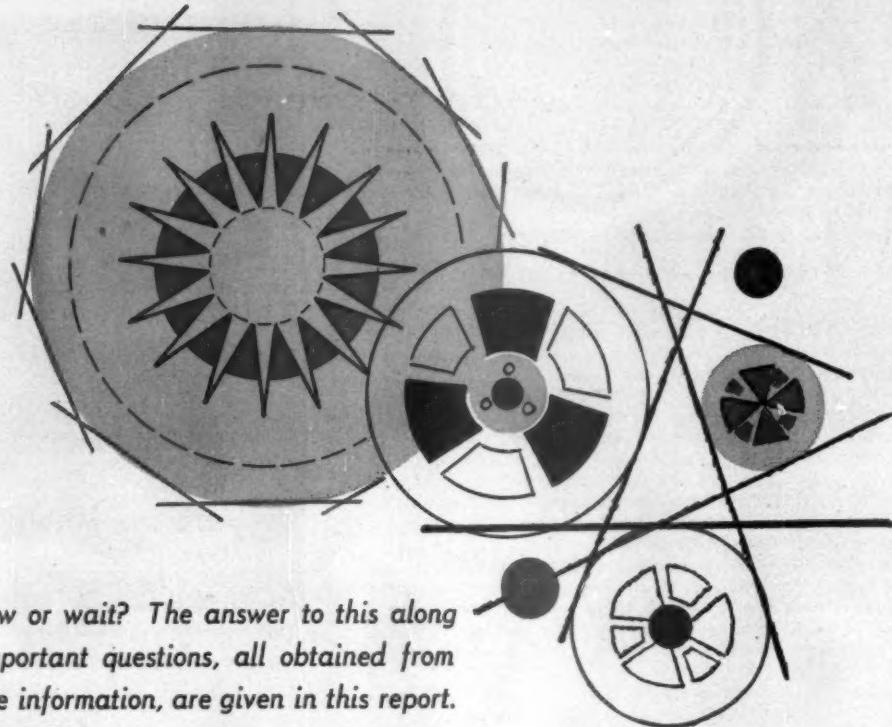


Two-track (A) and four-track (B) tape. In latter case, reel is turned over and heads play tracks 2 and 4. Or, tape direction is reversed and heads are either moved down or else other heads may be employed to play back stereo tracks 2 and 4.

View showing the inside of a tape magazine or cartridge that is loaded with bi-directional twin-track 3 1/4 ips tape.



behind the Stereo Scene



Buy stereo now or wait? The answer to this along with other important questions, all obtained from the best inside information, are given in this report.

AT a recent professional meeting held to demonstrate and discuss the different systems of stereo reproduction, a representative of one of the magazines was heard privately quizzing the chief engineer of one of the large companies which makes both discs and tape, as to which of the newly available (or nearly available) systems he would recommend.

The big man was persistently non-committal, not just as a matter of policy, but, as he expressed it, "We are in business to make all media available and let the consumer take his choice." "But which would you advise him as best?" the reporter persisted.

If he had any personal preference he wasn't saying. His questioner obviously thought he did have a preference he was not prepared—or permitted—to express. We don't agree. We believe most people in the industry are in the same position as this engineer—they don't know what the public will ultimately prefer.

We have quite a variety of new systems to pick from: several types of disc and two main varieties on tape; and each of them shows considerable potential for future development. Small wonder that those "in the know"—if they are honest and have no axe to grind—find themselves non-committal. But, like the reporter, most of us find such a reply somewhat unsatisfactory.

The state of not knowing what will come next is not good for business, either. Processors of 7.5 ips tapes, both monaural and stereo, report (again unofficially) that recent announcements have reduced sales of these tapes. Tape recorders have suffered a setback in sales too. Everyone, manufacturer and consumer alike, fears obsolescence.

Some phrase their questions as if there is a tape *versus* disc issue. To get a perspective on this, let's look back a bit. Before stereo showed around the corner, monaural tapes found themselves a market alongside the very good LP discs that were then available. Maybe some of the tape people hoped to "take over" the disc market, but really these were parallel, rather than competitive, markets.

The disc suits the "quick-and-easy" user, while tape is for the man who likes that form, for one reason or another (more of this in a moment). Then came stereo. Until the advent of disc, tape had a head start with this new medium (discounting for the moment the Cook binaural disc). They could "scoop the field" with stereo.

Finally stereo on disc "got off the ground"—with a variety of possible systems, yet! Some saw this as the death knell of the tape market—although we couldn't go along with this view. Whether for this reason, or for any of a variety of other grounds that have been suggested, the tape cartridge now hove into view.

Between the stereo disc and the projected new tape cartridge—oh, yes, there are samples of it around, too—the conventional tape market is suffering a hiatus. Everyone is waiting to see which way the "cat will jump." So let's try and answer some of the questions most frequently asked, by the best inside information—and inspired guesswork—obtainable.

What are the prospects on disc and how will the stereo disc of the future compare with the LP of today (or is it yesterday already)?

To this question one can get a variety of answers. Many have noticed

already that stereo discs—or many of them at least—are not really compatible with the monaural LP's. The incompatibility consists in two differences: the level on stereo records is usually lower than on the LP's; and the quality, both in frequency range and apparent distortion, is inferior when these discs are played monaurally.

Some stereo protagonists point out that, played on stereo equipment, they sound as loud as LP's without any more amplification; and the frequency response sounds as good as an LP, without more noticeable distortion. But the perfectionist group doesn't want stereo if it means a retrograde step in quality in any respect.

The CBS development of the "compatible record," announced this spring, aroused the ire of the latter group. "You cannot meddle with the program like this without causing distortion," they proclaimed. As impartial listeners, we were able to detect some distortion in the demonstration material, but many seem to think that maybe CBS "bent over backwards" on the compatibility issue and got it "too compatible."

Pursuing this thinking, some adaptation of the philosophy behind the CBS development will probably influence the future of stereo discs; most, if not all, the record companies will end up using some record device, or at least some adaptation that will allow greater horizontal stylus motion than vertical, without noticeable distortion. But nobody will say anything officially at this juncture. Whatever they are doing is well-kept under their respective "hats."

Despite what perfectionists may say or think, there is nothing underhanded

about this kind of "trickery"—if it is done (at the moment it is only conjecture). The objective of high-fidelity, and now stereo, is to achieve the most realistic illusion possible. If a company uses an unorthodox method to produce a better illusion of realism and the result is acceptable, what is unethical?

The trouble is, many of these perfectionist audiophiles listen with their thinking faculty rather than their hearing faculty. What they hear is what they expect it to sound like. But give them a good recording, without telling them how it is made

What about channel separation, that much-stressed question?

In view of the fact that cross-mixing is sometimes deliberately employed to get desired effects during the recording process, it is difficult to see how a little transfer from one channel to the other (even with less separation than 20 db) could interfere appreciably with the stereo effect or cause apparent distortion, in itself. In fact, from this viewpoint, 15 db of separation is probably more than adequate.

But cross-modulation that allows such transfer may also permit other troubles, such as intermodulation between channels. There is no saying it will, but it may. This is not so easy to measure—yet, so the insistence on a high degree of separation is at present the only way of safeguarding against these kinds of distortion.

The *Westrex* cutter, by the way, has quite a system of mechanical resonances between 9000 and 12,000 cycles capable of introducing similar troubles in recording. For this reason some companies, with very good cause, roll off the high end at about 8000 cycles in recording stereo. This will account for a noticeable difference between stereo records played monaurally and LP's with a response out to 15,000 cycles and more.

Several other stereo cutters are known to be "in the works" and some have reworked the *Westrex* to push its troublesome region to a higher frequency, so this acceptance of inferior recording quality on stereo is undoubtedly only very temporary. It does not mean any change of system is necessary to effect the improvement needed.

What about the Minter system and other possibilities?

The multiplex principle used by the *Minter* system is not new, but the quality he has achieved with it is relatively new. Possibly, had he produced these results a little sooner, his system might have had the 45-45 "beaten to the draw." But what chance does it stand now?

This is another question capable of eliciting different answers. Some say there can only be one system, so *Minter's* will have to fizzle out. But the system definitely has merits and, for this reason, it will probably find itself a continuing, but small market.

Many readers will remember the
(Continued on page 146)

COVER STORY

THIS month's cover is symbolic of the theme "Stereo Tape or Disc?" which has been carried throughout the entire issue. For a direct answer to this question don't miss the articles appearing on Pages 8 and 40. The final answer is not a simple one and to some the disc seems to be the solution while to others the trend would be towards tape. The hi-fi enthusiast who has no budgetary problems, is interested in recording, and desires maximum quality sound reproduction and convenience will probably have both tape and disc. One such system is shown on this month's cover.

CBS Television star Richard Boone, well known for his portrayal of Dr. Konrad Styner in the "Medic" series and Palladin in "Have Gun, Will Travel," has a stereo tape on the Ampex Model A 124-U tape deck. This basic recorder-stereo reproducer has a rated frequency response of from 30 to over 16,000 cps, and operates at either 3 3/4 or 7 1/2 ips, with a maximum reel size of 7 inches. Outputs from the tape unit are fed into two matching amplifiers (not shown).

In order to play stereo discs, the Garrard Model 301 "The Professional" transcription turntable is used along with the Garrard TPA 10 tone arm. The turntable is a three-speed unit incorporating a useful speed adjusting control to enable the precise speed to be obtained. This speed control operates as an eddy-current brake formed by the interaction of a permanent magnet with a revolving metal disc.

The tone arm is fully adjustable for length, tracking angle, and stylus pressure. It has a

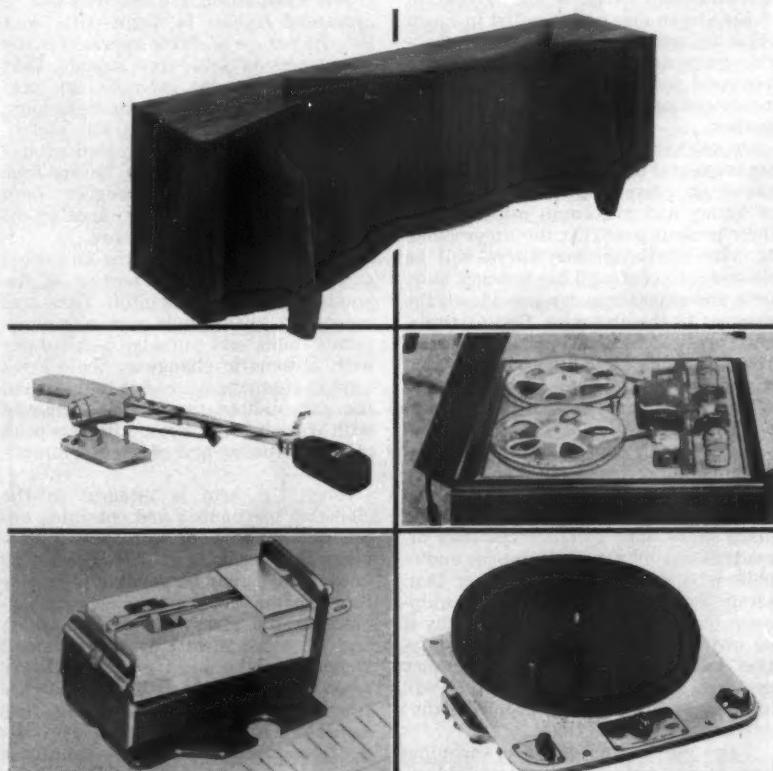


universal shell that takes just about any cartridge. In the installation shown an Electro-Voice Model 21D stereo cartridge is used. This cartridge is ceramic type with a .7 mil diamond stylus. The .5 volt output from each of the two ceramic elements is applied to the same amplifiers used for the tape deck.

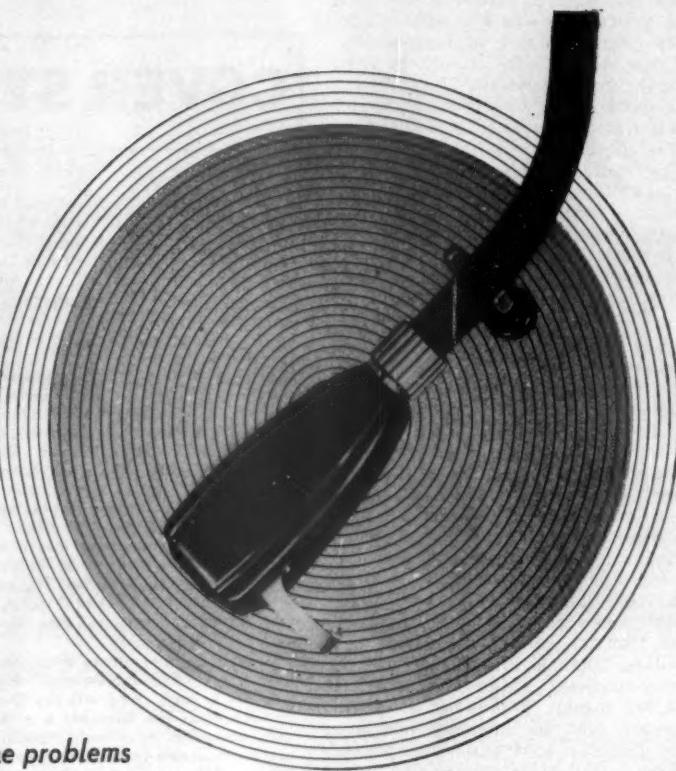
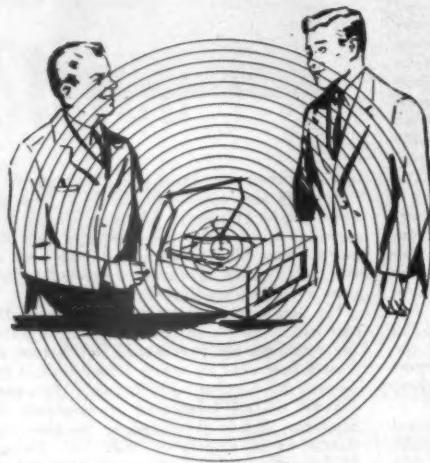
The impressive-looking structure along the rear wall is the stereo speaker system to which the amplifiers are connected. This system, almost 9 feet wide by nearly 3 feet high, is the James B. Lansing JBL-Ranger "Paragon" (Model 44000) integrated stereophonic reproducer. It was developed by the above organization in association with Col. Richard H. Ranger, who has made major contributions in tape recording and motion picture sound.

The speaker system uses a large curved surface which, in effect, serves to spread the stereo illusion over a wide area. Two 15" woofers, horn-loaded by the enclosure, two horn-loaded mid-range drivers (covering 500 to 7000 cps), and two ring radiators (above 7000 cps) make up the speaker complement.

(Photo: Dale Haley.)



Converting to STEREO DISC



Technician and audiophile can meet the problems of satisfactorily adapting existing disc players.

THE IMPRESSIVE degree of popular enthusiasm greeting the advent of the stereo disc has resulted in much rejoicing among manufacturers of audio equipment. The service technician has good reason to join in the general merrymaking, but also some cause for caution.

On one hand, many people with existing monaural equipment will be seeking advice on converting with a minimum of outlay and maximum utilization of their present gear. On the other hand, as with anything new, there will be obstacles to confound the unwary. Only time and experience can provide all the answers to the obstacles. Failing these, however, much can be done in the way of anticipating difficulties, thus making it possible to skirt some altogether and at least to suggest techniques for handling others.

As to master control units, preamplifiers, amplifiers, and speaker systems, the matter of adding another channel to the existing one is being solved in many ways with commercial units already available. However, for the audiophile who wishes to adapt rather than scrap existing record-playing equipment, care will be needed, especially if he owns a changer. Informed speculation indicates that, while some new problems will arise, much attention will have to be given to old problems that will become more serious.

Take the matter of noise, including hum and rumble. Monaural cartridges,

designed to respond mainly to lateral groove modulation, are less sensitive to unwanted signals to begin with. And yet, the nature of stereo aggravates the seriousness of unwanted signals. Disc manufacturers, for example, are preparing to take special pains in keeping their surfaces noise-free for stereo. Pops and clicks gain increased prominence in three dimensions. Noises that come from a specific direction—and perhaps tend to wander to another direction—are difficult to ignore.

The fact that much of the unwanted signal is at the lowest portion of the audio spectrum is helpful. Tone-arm resonance, for example, serves to exaggerate hum and rumble, particularly with automatic changers: their arms tend to resonate somewhat higher than the sub-audible frequencies achieved with transcription arms. Also this peak may be broader and of greater amplitude.

Since the arm is integral to the changing mechanism and obtaining another compatible one with a lower resonance is a heroic task, it is cheering to know that it may be possible to reduce the resonance of an existing arm. Increasing the mass of the arm, which can be accomplished by adding small weights at the head end, will lower resonance. True, this will also increase tracking force, but a countermeasure is available. Every respectable arm has a stylus-force adjustment—usually a spring in a changer—that will compen-

sate for at least some added weight. This very technique has been used by some manufacturers who have redesigned their tone arms for stereo use.

If low-frequency phenomena continue to be a problem, filtering can be used. While sharp cut-off, high-pass networks are nothing new, remember that two similar filters are now needed, one for each channel. Fortunately, those systems in which hum and rumble are likely to be so much of a problem that filtering is required are also probably those in which the loss of extreme lows will tend to be less noticeable, since those frequencies may never have passed through the speaker to begin with.

Some may wonder why, if the speaker cannot handle the very bottom of the audio band, special consideration is required here. Although these tones may not be reproduced directly, they can interact with other signals in the response range to produce unfortunate audible effects.

Another approach to hum lies in the choice of the stereo cartridge. A piezoelectric pickup will tend to show low hum sensitivity. Thus a modest system whose record playing device tends to introduce more hum than is acceptable might fare better with a cartridge of this type. In any case, where the existing monaural pickup is already a crystal or ceramic unit, the switch to stereo is not a good opportunity for also

(Continued on page 152)

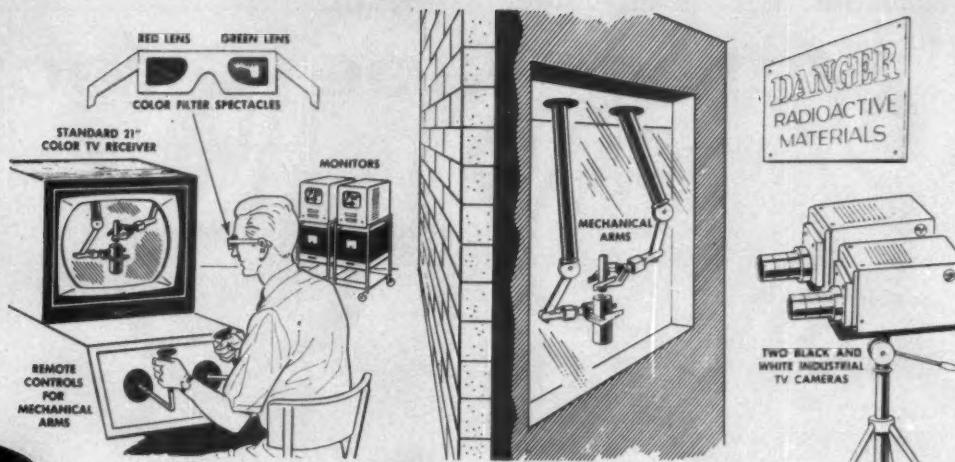
3 DIMENSIONAL TV SYSTEM

By L. I. MENGLE
RCA Electron Tube Div.

THREE-DIMENSIONAL closed-circuit television systems are extremely useful for the remote observation of many processes and for the supervision of hazardous handling and control operations. Although various three-dimensional systems have been described, these systems depend either on mechanical devices such as rotating shutters or on complex photo-optical devices using polarized light and/or dichroic mirrors to provide stereoscopic viewing. This article describes a simple, all-electronic, three-dimensional television system which uses standard camera equipment and a standard color-television receiver. This system, originated by D. H. Pritchard and W. G. Gibson of *RCA Laboratories*, Princeton, N. J., provides simultaneous presentation of the left and right images and permits stereoscopic viewing in either yellow or black-and-white.

The new system employs two *RCA* Type ITV-6 black-and-white television camera-monitor units as pickup devices and a standard commercial *RCA* 800-Series color television receiver equipped with a 21CYP22 color picture tube as the display device. A video amplifier having flat response to 7 megacycles and a voltage gain of 140 is used between each camera and the 21CYP22. Observers view the simultaneous two-color display through spectacles equipped with two *Kodak* "Wratten" color filters: No. 29 (red) for one eye and No. 61 (green) for the other.

The system is shown in block-diagram form in Fig. 1. The two cameras are mounted on the same tripod, with the optical axes of their



Two black-and-white industrial TV cameras (at right) focus on mechanical arms as they load radioactive material into container. Signals from cameras are applied to color TV receiver picture tube. A technician, in a safe area and wearing suitable glasses, uses the 3-D image to operate arms by remote control.

New closed-circuit system is all-electronic, uses standard camera equipment, and color-TV receiver.

lenses in the same horizontal plane and having approximately the same separation and convergence as the average pair of adult human eyes. The right-hand camera, therefore, "sees" a subject as it would be seen by the right eye and the left-hand camera as it would be seen by the left eye.

The 21CYP22 is operated with normal electrode voltages and scanning, and standard procedure for static and dynamic convergence of the three beams is followed during setup of the receiver. The amplified output of one camera is applied to the red gun of the 21CYP22 color picture tube in the receiver and the amplified output of the other camera to the green gun. The blue gun of the 21CYP22 is not used and is biased to cut-off. When the simultaneously displayed red and green fields are viewed through the goggles, they produce a stereoscopic subjective image in yellow.

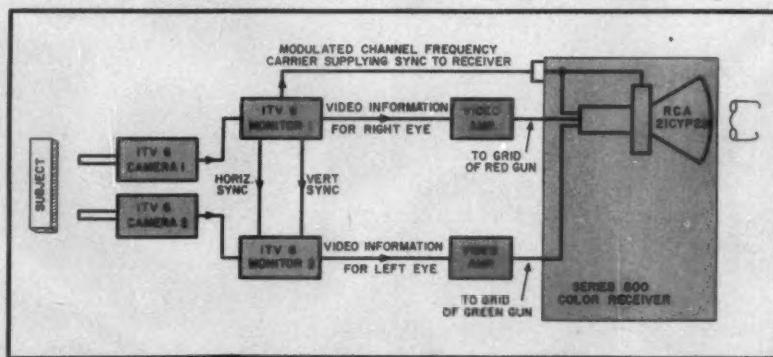
The output of either camera chain may be applied to either the red or green gun of the 21CYP22, provided the relative positions of the red and green color filters worn by the observer are the same as the corresponding cameras.

Each Type ITV-6 camera contains a complete sync-pulse generator which may be used as a source of synchronizing pulses for the entire system. The unused sync generator is disabled. The composite video-modulated channel-frequency signals which are available at the "R.F.-Output" jacks on the monitor units simplify synchronization of the receiver since these signals can be applied directly to the receiver antenna terminals.

Black-and-White Viewing

If black-and-white stereoscopic images are desired, the blue gun of the 21CYP22 can be driven in parallel with (Continued on page 128)

Fig. 1. Block diagram showing operation of closed-circuit, three-dimensional TV system.



Stereo Tape Directory

Listing of manufacturers of 7.5 ips recorded tapes, labels, repertoire, and prices. This directory includes only two-track tapes for use on machines with in-line heads. Four-track 3.75 ips recorded stereo tapes, which have recently been announced, are reported to be available only in cartridge form from RCA Victor. RCA plans to have sixteen of these four-track tape cartridge packages on the market by the first of October.

CORPORATE NAME AND ADDRESS	LABELS	Class.	Semi-Class.	PROGRAM Pop.	Jazz	Spoken	Other	REEL SIZE	PRICE RANGE
Audio Arts, Inc. 5807 Melrose Ave. Hollywood 38, Calif.	Stereotape	X	X	X	X			7"	\$7.95-\$11.95
Audio Fidelity, Inc. 770 Eleventh Ave. New York 18, N. Y.	Audio Fidelity Stereo Mastertape			X	X	X		7"	\$12.95
A-V Tape Libraries, Inc. 396 George St. New Brunswick, N. J.	A-V Recorded Tapes	X	X	X	X		X	7"	\$9.95
Bel Canto 2919 S. La Cienega Blvd. Culver City, Calif.	Bel Canto	X	X	X	X		X	7"	\$3.95, \$7.95, \$9.95, \$11.95
Capitol Records, Inc. Capitol Records Distributing Corp. P.O. Box 2391 Hollywood 38, Calif.	Capitol	X	X	X	X			7"	\$9.95-\$16.95
Celestial 120 W. Thomas St. Seattle 98, Wash.	Celestial	X	X	X	X			5", 7"	\$8.95-\$10.95
Columbia Records 790 Seventh Ave. New York, N. Y.	Columbia	X	X	X	X			7"	\$10.95-\$23.95
Concertapes, Inc. P.O. Box 88 Wilmette, Ill.	Concertapes	X	X	X	X	X		8", 7"	\$7.95-\$11.95
Cook Laboratories, Inc. 101 Second St. Stamford, Conn.	Cook	X		X	X		X	7"	\$12.95-\$14.95
Craft Recording Corp. 1680 Broadway New York, N. Y.	Stere-o-Craft			X	X			7"	\$8.95-\$10.95
Criterior Recording Co. 3890 Biscayne Blvd. Miami, Fla.	Criteriatape					X		5", 7"	\$8.95-\$11.95
Custom Recordex 7390 Lawyer Road Cincinnati 44, Ohio	Custom Recordex	X	X				X	7"	\$10.95
Elektra Corporation, The 361 Bleeker St. New York 14, N. Y.	Dyna-Tapes			X	X		X	7"	\$11.95
Esoteric Records, Inc. 333 Sixth Ave. New York, N. Y.	Counterpoint	X		X	X		X	7"	\$11.95-\$14.95
Experiences Anonymes 20 East 11th St. New York 3, N. Y.	EA Experiences Anonymes	X				X		7"	\$14.95
Fantasy Records 684 Natoma St. San Francisco 3, Calif.	Fantasy	X	X	X	X			7"	\$8.95-\$11.95
Fidelity Distributors 7803 Sunset Blvd. Hollywood, Calif.	Hifitape		X	X	X			7"	\$12.95
Good Time Jazz Record Co., Inc. 8481 Melrose Place Los Angeles 48, Calif.	Contemporary Tape	X			X			7"	\$11.95
Grand Award Record Corp. 6 Kingsland Ave. Harrison, N. J.	Grand Award			X				7"	\$9.95
International Pacific Recording Corporation 884 N. Vine St. Hollywood 38, Calif.	Omegatape Alphatape Jazztape	X	X	X	X	X		7"	\$8.95-\$14.95

CORPORATE NAME AND ADDRESS	LABELS	Class.	Semi-Class.	PROGRAM Pop.	Jazz	Spoken	Other	REEL SIZE	PRICE RANGE
Kandy Tapes & Records Corp. of Indiana Room 2109, 203 N. Wabash Chicago 1, Ill.	Kandy		X	X				7"	\$7.95
Klipsch and Associates P.O. Drawer 96 Hope, Ark.	Klipschtape	X	X	X	X			7"	\$13.95
Livingston Audio Products Corp. P.O. Box 202 Caldwell, N. J. (acts as distributor for some of the labels listed)	Livingston, Boston, Connoisseur, Empiri- cal, Esoteric, Oceanic, Riverside, Hack Swain, Period, Dyna-Tapes, El- ektra, Atlantic, Lyri- chord, Tico, Add-the- Melody	X	X	X	X			5", 7"	\$6.95-\$17.95
Manhattan Recording Corp. 1650 Broadway New York 19, N. Y.	Manhattan	X	X	X	X		X	7"	\$6.95
Mercury Record Corp. 35 E. Wacker Drive Chicago 1, Ill.	Mercury	X	X	X	X			7"	\$3.95-\$18.95
Montilla Long Playing Records from Spain 131 East 23rd St. New York 10, N. Y.	Montilla	X	X	X				7"	\$8.95-\$13.95
Music Therapy Records 415 Marine St. Santa Monica, Calif.	Music Therapy						X	7"	\$5.95 ($\frac{1}{2}$ reel)
National Tape Library 810 F Street, N.W. Washington, D. C.	National	X		X	X		X	7"	\$6.00-\$11.95
Paramount Enterprises, Inc. 383 Concord Ave. New York 54, N. Y.	Hallmark		X	X	X		X	7"	\$9.95
Pentron Corporation, The 777 S. Tripp Ave. Chicago 24, Ill.	Pentape		X		X			7"	\$6.95
Period Music Company 304 E. 74th St. New York 21, N. Y.	Period	X		X	X		X	7"	\$11.95
Recorded Tape of the Month Club, Inc. 448 W. 51st St. New York 19, N. Y.	Tape of the Month	X	X	X	X		X	7"	\$10.95
RCA Victor 155 E. 24th St. New York 10, N. Y.	RCA Victor	X	X	X	X		X	7"	\$6.95-\$18.95
Replica Records, Inc. 7210 Westview Drive Desplaines, Ill.	Replica			X	X			5", 7"	\$7.95
Stereophony, Inc. 112 Oak Plaza St. Paul 9, Minn.	Stereophony		X	X	X		X	5", 7"	\$1.95-\$9.95
Tape-Athon Music, Inc. 523 S. Hindry Inglewood, Calif.	Tape-Athon	X	X	X	X		X	7", 10"	\$40 (4 hrs.)— \$85 (8 hrs.)
Vanguard Tape Corp. 256 W. 59th St. New York 19, N. Y.	Vanguard Record- ing Soc., Bach- Guild	X	X	X	X	X		7"	\$7.95-\$14.95
Verve Records, Inc. 451 N. Canon Drive Beverly Hills, Calif.	Verve, Real o' Gold			X	X			7"	\$12.95
Welton, James, et al 2847 Elsie St. Los Angeles 26, Calif.	Protone, Recotape, Clown	X	X	X	X	X	X	7"	\$2.95-\$9.50
Westminster-Sonotape Sales Corp. 275 7th Ave. New York 1, N. Y.	Westminster, Sono- tape	X	X	X	X			7"	\$6.95-\$17.95
WFB Productions 637 E. Broad St. Souderton, Pa.	WFB		X					7"	\$9.95
Zodiac Recording Co., Inc. 501 Madison Ave. New York 23, N. Y.	Zodiac	X	X	X				7"	\$11.95

The H. H. Scott StereoMaster 130

RADIO & TV NEWS
LAB TESTED

A hi-fi stereo preamp
that incorporates, in
one package, all the
possible features that
anyone would desire.



Front panel view of stereo preamp showing arrangement of all the operating controls.

SINCE stereo is in vogue we would be rather remiss in not including in this issue a review of a stereo component. The H. H. Scott Model 130 stereo preamplifier described here is typical of what can be achieved with careful design and it illustrates the capabilities of equipment which is available from many manufacturers of higher-quality hi-fi. This particular unit incorporates, in one package, just about all those features that anyone could possibly desire in a stereo unit. It features bass, treble, balance, and volume controls; rumble and scratch filters; input selector switch; stereo selector switch; phase reversal switch; and has an output jack for the connec-

tion of a third stereo channel. It can be used for complete stereo playback or recording from AM-FM receivers, phono discs, or tapes.

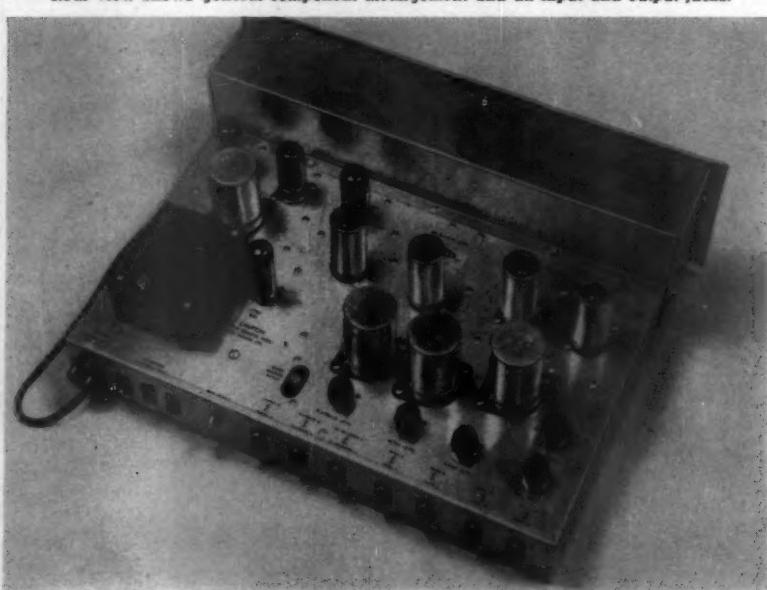
The above is a very impressive list of functions and no doubt many users of such equipment would probably ask whether or not they are all important. This same question has come up time and time again in connection with monaural control units and there are arguments on both sides. Certainly for single-channel sound reproduction one could get by with a preamplifier that has nothing more on it than a conventional selector switch, volume control, and an "on-off" switch. Of course, some would prefer to add a bass, treble, or

even a loudness control to their systems and, again, it would be nice to have rumble and scratch filter controls. The latter two are not of extreme importance if, for example, you are using the best quality turntable or tape deck and if all of your records are of the highest quality and in the best condition. Again, these two controls are not really necessary if, for example, your power amplifier and speaker system do not reproduce sounds at the extreme low and high ends of the audio spectrum. On the other hand, if you have a turntable or record changer that presents rumble problems, and particularly if your system is truly hi-fi in that it covers both the extreme low and high ends, it would be almost a necessity to have available, at least on occasion, such controls as the rumble and scratch filters. Basically the required design depends more or less on the type of equipment you are using and on your budget.

When it comes to stereo the problem is somewhat different. There are quite a few features in a control system that one could probably do without but many will very likely find them to be a necessity. We cannot argue the point that the most basic system, one that employs two of the simplest types of single-channel preamplifiers, could be used for stereo with, of course, accompanying dual power amplifier and speaker systems but it is hard to believe that a person could be truly satisfied with this type of operation.

When playing stereo discs or tapes one must keep in mind the fact that sounds from the left side of the program source must emanate from the left-hand speaker and, similarly, the sounds at the right side of the program source must emerge from the right-

(Continued on page 162)



Stereo amplifier, shown here, with matching power supply (left), is built in 5"x7"x3" chassis.

Simple STEREO Amplifier

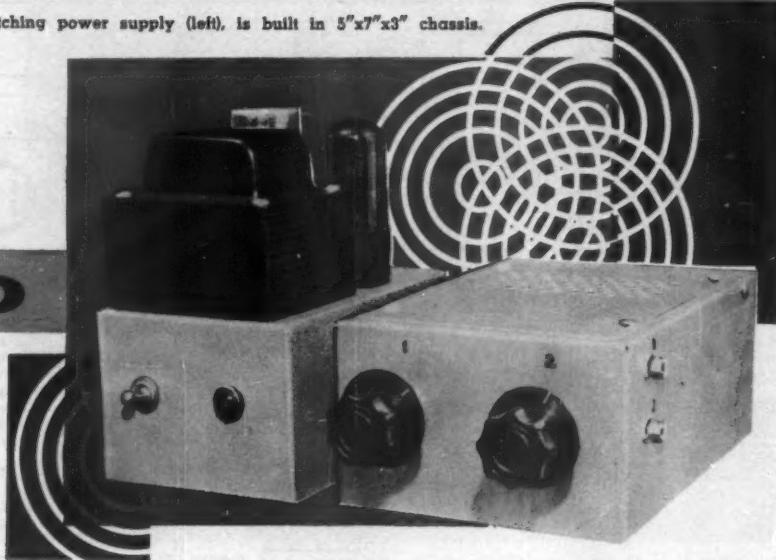
By
ROBERT W. TIMMERMAN

THE amplifier described here was developed with the twin objectives of economy and compactness as a complete unit for stereo service. The resulting amplifier is in the low-power class, however its output is adequate for monitoring or for normal home listening with speakers of moderately high efficiency. It will operate directly from a ceramic-type stereo pickup cartridge. Standard circuits and readily obtainable parts are used. The cost of building the amplifier and power supply will be between \$25 and \$35, excluding labor. If a suitable power supply is available, parts for the amplifier itself will run around \$15 to \$20.

The amplifier proper is built within a 5"x7"x3" chassis, using somewhat unconventional layout and mechanical details which will be described later. The power supply, which may be located at some distance from the amplifier, is built on a 4"x6"x3" chassis.

Circuit

The circuit diagram of the amplifier is shown in Fig. 1. It consists of two identical, but independent, amplifiers. A twin-triode 12AX7 is the voltage-amplifying first stage for each channel. Each output stage is a type 6973 beam-power tube operating single-ended. About 8 db of voltage feedback is applied from the secondary of each output transformer to the cathode of the corresponding 12AX7 triode section. Resistors R_4 and R_5 make up the feedback voltage divider for Channel 1 while R_{11} and R_{12} perform the same function for Channel 2. Eight db is about the maximum amount of feedback that can be used with inexpensive transformers and with the limited gain available in the two amplification stages. The input signals are applied to individual volume-control potentiometers R_1 and R_2 . Conventional coupling and cathode bias circuits are used. The 6973 power-amplifier tubes



Compact 3-tube amplifier operates directly from ceramic stereo cartridge, easily drives high-efficiency speakers.

are operated with distributed screen (Grid No. 2) load through the use of center-tapped output transformers.

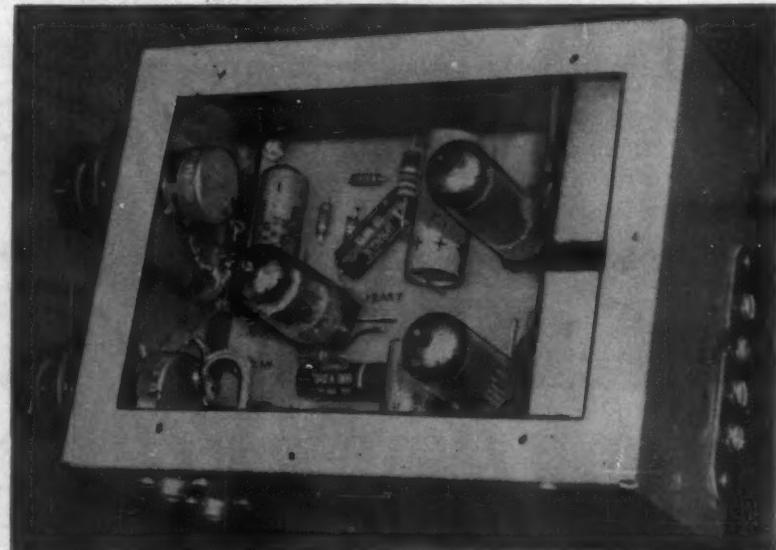
Fig. 2 is a schematic of the power-supply circuit. It is conventional with the possible exception of R_4 , which is an adjustable resistor allowing precise setting of the high voltage for maximum power output with minimum distortion. Resistor R_2 and capacitor C_2 provide extra filtering for the voltage amplifier stages. A 5-wire cable connects the power supply to the amplifier.

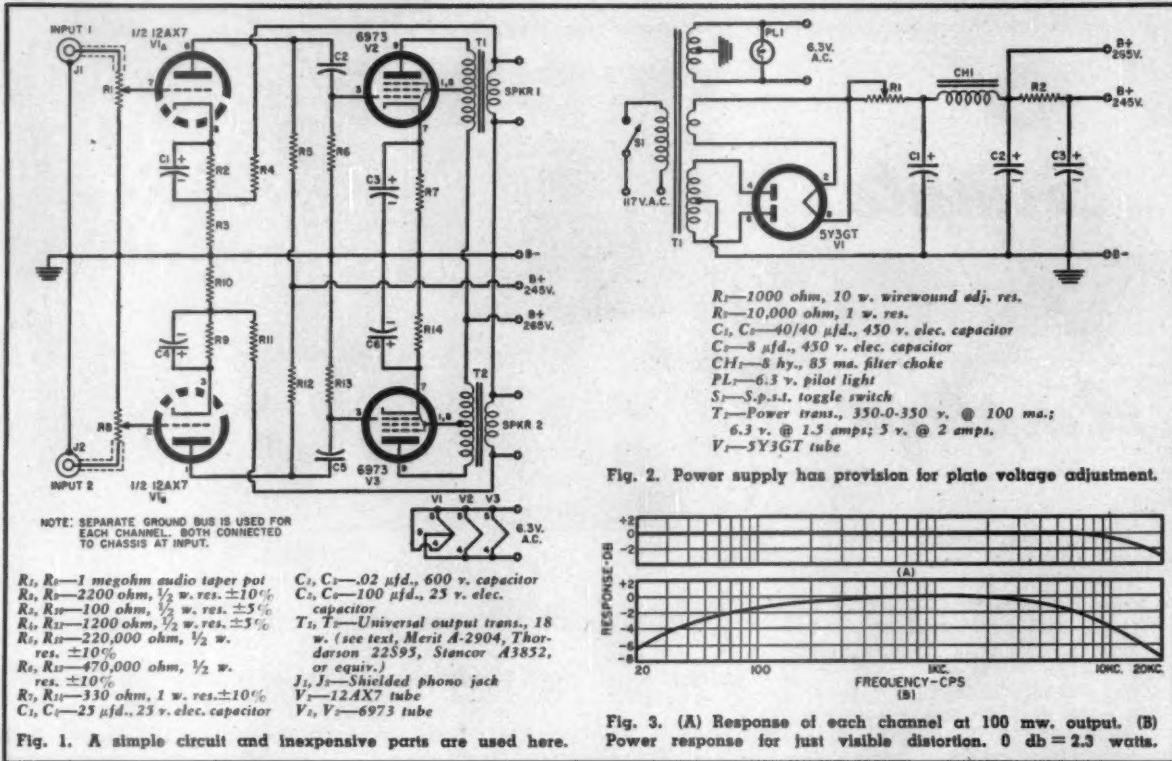
Mechanical Features

The amplifier was planned so as to

incorporate a printed (etched) circuit. While printed circuits were originated primarily for economy in mass production, this technique is also usable in home construction projects. Slightly more time is required for planning and layout, compared to conventional design, but final assembly is accomplished very quickly and a permanent, compact, and rugged unit results. Moreover, additional interest is created for the audiophile who derives pleasure from construction as well as from operation of his equipment. Information is given here to permit duplication of the author's etched-circuit amplifier. Other arrangements of parts

Top view of the stereo amplifier is shown here with perforated cover removed.





would be satisfactory or the components can, of course, be assembled and wired in traditional style, if desired.

Components

All of the electrical parts for the amplifier and power supply are standard items, readily available from mail-order and local supply houses. The essential specifications are given in the parts lists accompanying Figs. 1 and 2 and require no comment except for the output transformers. In keeping with the economy objective of this

project, relatively low-priced transformers are specified. To be assured of adequate direct-current-carrying capacity in the primaries and to go at least partway toward minimizing core saturation effects of single-ended operation, nominal 18-watt transformers are recommended, even though the maximum power output per channel is two to three watts. The "universal tube-to-voice coil" type provides a center-tapped primary and a multi-tapped secondary. Secondary taps should be chosen to give an impedance

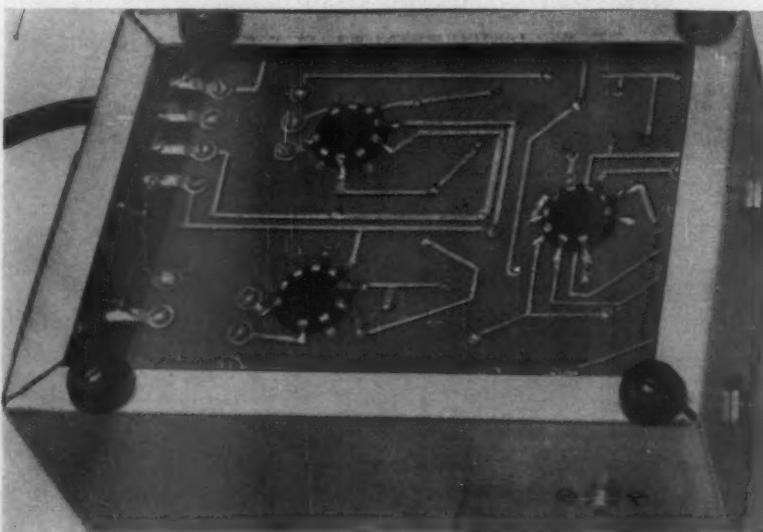
ratio of approximately 4000 ohms (full primary) to 8 ohms secondary. The primary center-tap is connected to grid No. 2 of the output tube. Only one pair of output terminals is provided for each channel, which on measurement and listening tests actually operates satisfactorily with speakers rated from 4 to 16 ohms.

Construction

Assuming that the etched circuit technique will be used, the first step is to lay out the circuit board. With Figs. 4 and 5 and the photos as guides, locate the terminal points and conductor routes in full scale on a sheet of thin paper. Final size of the phenolic, copper-clad board is $4\frac{1}{2}$ " by $5\frac{1}{2}$ ". Slight adjustments may be required to accommodate the dimensions of the components to be used. After completing the layout and making a thorough double check, the conductor lines are traced onto the copper face of the circuit board with carbon paper. The writer has found it convenient at this stage to mark with a center punch each point at which a hole is to be drilled. These points include terminals of all components as well as input, output, and power-supply connections and the centers of the tube-base circles.

Application of the "resist" ink is next. This technique has been described by Middleton and Marshall in the August 1954 issue of *QST* and the reader is referred to this article or other sources for details. *Union Ink Company Type C-992* resist was used by the author. Tabs for the tube con-

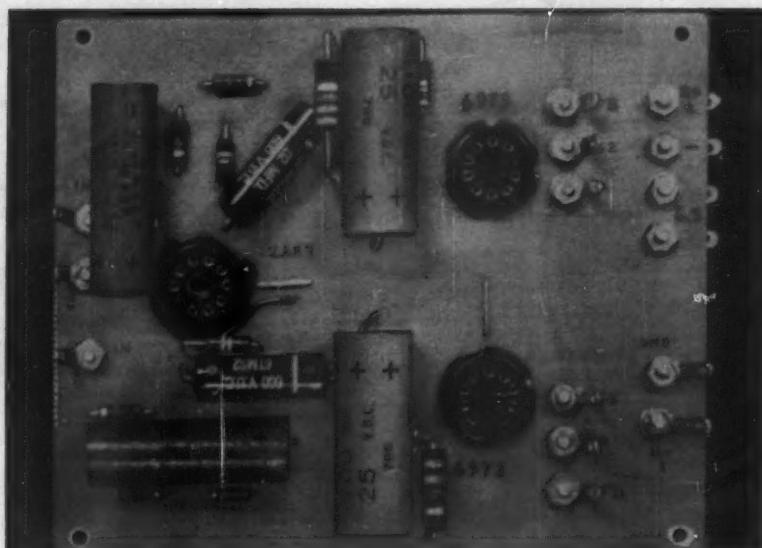
Bottom view. Printed circuit board is mounted by four corner bolts which also hold the rubber feet. Terminals for power cable are at the left edge of board.



nctions should be matched to the sockets. Snap-in sockets, such as *Eby* PC-9, are recommended. Terminals for external connections should be made about $\frac{1}{16}$ " in diameter to provide firm connections to soldering lugs fastened by No. 4 bolts. Etching away of the unwanted copper areas is then carried out with warm 30% ferric chloride solution. The resist is finally washed off with solvent, leaving the copper conductor pattern exposed and intact.

The circuit board is prepared for the mounting of the parts by cutting the tube socket holes, filing them carefully to size, and then drilling small holes for the pigtails terminals. A No. 60 drill is the correct size for most components. One-eighth-inch holes are drilled at the external connection points. Pigtails of the components are then bent to fit the required mounting centers and the parts are mounted in their proper places on the top side of the board. The tinned pigtails should extend about $\frac{1}{2}$ " out from the circuit side. Each pigtail is soldered to its terminal, using minimum amounts of solder and heat. The tube sockets are inserted in proper orientation and each terminal is soldered in place. Small soldering lugs are attached by 4-40 bolts, lock washers, and nuts at the input, output, and power-supply terminals. This type of connection is preferable to soldering of external wires directly to the etched circuit conductors, as strain on the wire could readily pull loose the copper foil.

After completion of the circuit board, attention may be given to preparation of the cabinet. A standard 5" x 7" x 3" aluminum chassis is the starting point. Holes are drilled for mounting the input jacks, volume controls, power cable, and the four-point output terminal strip. Locations of these items are not critical and may be judged from a study of the photographs. A rectangular opening is cut in the top of the chassis, leaving a $\frac{1}{8}$ "



Top view of the printed circuit board after all the components have been mounted.

Frequency Response: (100 mw.)	Flat 20-8000 cps; down 3 db @ 20,000 cps
Power Output: (low distortion)	2.3 w. mid-range; down 3 db @ 45 and 8000 cps
Input:	0.45 v. across 1 megohm for full output
Inverse Feedback:	8 db
Output Matching:	8 ohms nominal; feeds 4 to 16 ohms satisfactorily
Hum and Noise:	-73 db
Cross talk:	-51 db
Damping Factor:	3.2

Table 1. Performance data for each of the channels in the stereo power amplifier.

rim all around the entire top edge.

The circuit board is mounted by four 6-32 bolts, spaced $\frac{1}{4}$ " above the bottom with short pieces of tubing. The four rubber feet are also held by these board mounting screws. The feet are important since they elevate the amplifier above the operating surface to provide necessary ventilation. The circuit board is located near the front of the cabinet, leaving about $\frac{1}{4}$ " between the back edge of the board and the back inside of the cabinet. The latter

space is for the power cable and speaker terminal connections.

Shielded input leads are provided from the jacks to the volume controls. The controls are oriented to permit the shortest possible connections to the board input terminals.

The output transformers are installed last. Part of one mounting ear on each unit must be cut away to mount in the limited space available. The cut ear is located up and is held

(Continued on page 95)

Fig. 4. Bottom view layout of the 4 $\frac{1}{4}$ x5 $\frac{1}{8}$ -inch printed circuit board. Black lines show locations of copper conductors. Terminal points are shown by enlarged spots. Note that this drawing is not shown full size but is included for guidance only.

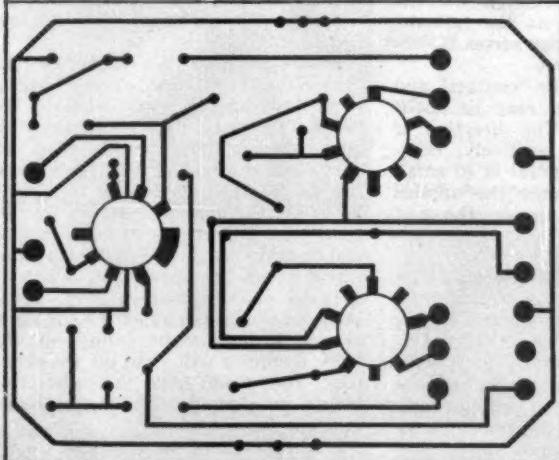
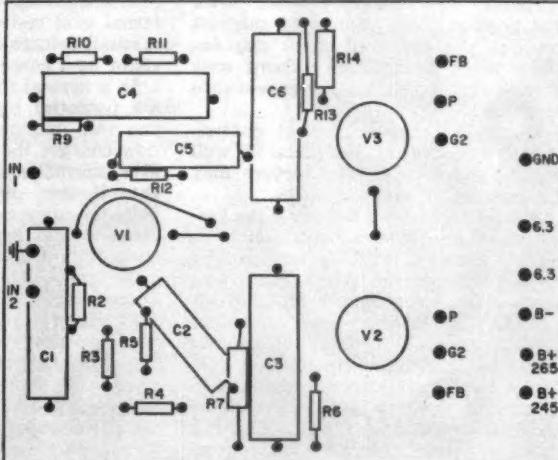
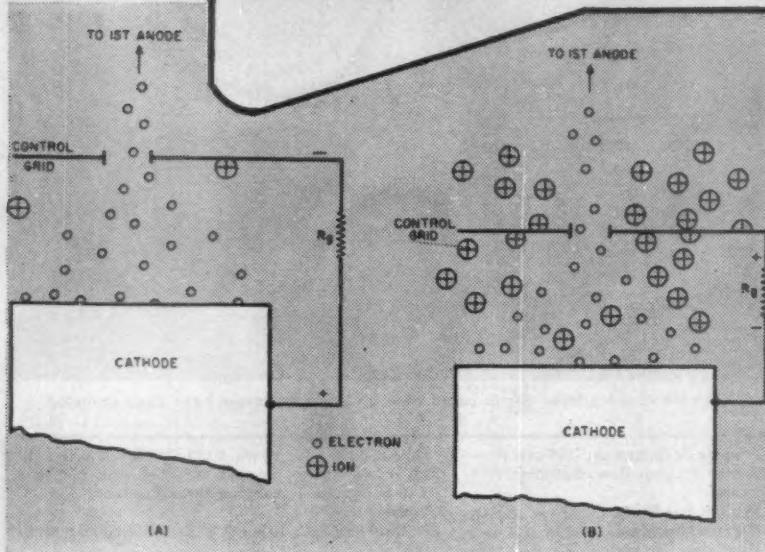


Fig. 5. Locations of components on the circuit board. This is a bottom "x-ray" view; the parts are actually mounted on the top side, opposite that of the etched circuit. In this case, just as with Fig. 4, the drawing is not shown full size.



FIELD TEST for



A relatively simple check with a voltmeter can help you clear up doubts about the CRT's quality.

AGASSY TV picture tube produces characteristic symptoms. As a rule, their prominence is directly proportional to the amount of gas present. Even a small amount of gas causes smearing of large areas of solid white, black, or gray, such as block lettering in titles. Some blooming and a variable amount of the "engraved" or partly negative picture effect are other clues. To further aid diagnosis, gas trouble develops slowly. However, causes other than a gassy picture tube may produce similar symptoms. So, when gas is suspected, make some simple, preliminary checks.

Rotate the contrast control. With gas present, little change of contrast results. The engraved effect may become more pronounced. Focus may change slightly, giving the appearance of blooming.

Manipulate the brightness control. It will not control brilliance so well with a gassy tube. The picture may go negative in some instances.

Should these tests heighten the suspicion of gas, tube substitution is in order. Since a CRT is not usually carried along in the caddy, other video tubes may be replaced temporarily, as a test: a bad video tube can cause similar effects. If this substitution technique fails to exonerate the CRT, resort to the grid-current check. Fig. 1 will help the technician to recall the principles behind this test. Fig. 1A shows a normal electron cloud (space

charge) in the space between cathode and control grid. Since like charges repel each other, the negative grid in a normal tube repels the negatively charged electrons, except at its aperture or hole. Enough electrons escape through this hole to form the electron beam after focusing.

All tubes have some gas. Gas atoms become ionized to form positive ions indicated by the larger circles with crosses in them. Because unlike (oppositely charged) particles or elements attract each other, the ions are drawn to the negative grid. The positive charge thus developed at the grid draws electrons up through the external grid resistor from the cathode. A small voltage develops across the resistor as a consequence.

In a normal tube, the "contact" and ion potential together may be about one volt maximum. The direction of flow charges the grid positively. However, normal ion potential is so small that it does not change the applied voltages appreciably; hence, the grid remains negative and the cathode positive, as in Fig. 1A.

As gas (and ionized particles) increase, the greater reverse grid current from this cause produces a higher reverse voltage drop. As indicated by Fig. 1B, the grid may even go positive. Grid potential relative to cathode is determined by applied voltages from the power supply and the video driving signal, plus the developed ion voltage.

Gassy Picture Tubes

Fig. 1. There are few gas ions (A) in a normal picture tube. As they increase (B), action between the electrodes in the cathode-ray tube undergoes change.

By
ROBERT JASON

For this reason, the symptom may range from an engraved picture (relatively mild gassiness) to a totally negative image. Mutual attraction between electrons and ions, particularly beyond the grid-cathode space, tends to defocus the pix as well as limit the brightness control's effect.

Grid Current Test

In the field, the technician does not carry a microammeter to place in the grid circuit. Also this is troublesome to accomplish in many instances. However, the technician does have a v.t.v.m. or high-impedance v.o.m. handy. Therefore he can meter the grid voltage developed by this current rather than the current itself. Generated voltage should be less than 1.5 volts as a maximum. Condemn the tube if the grid voltage developed by this undesired current flow is any higher than this.

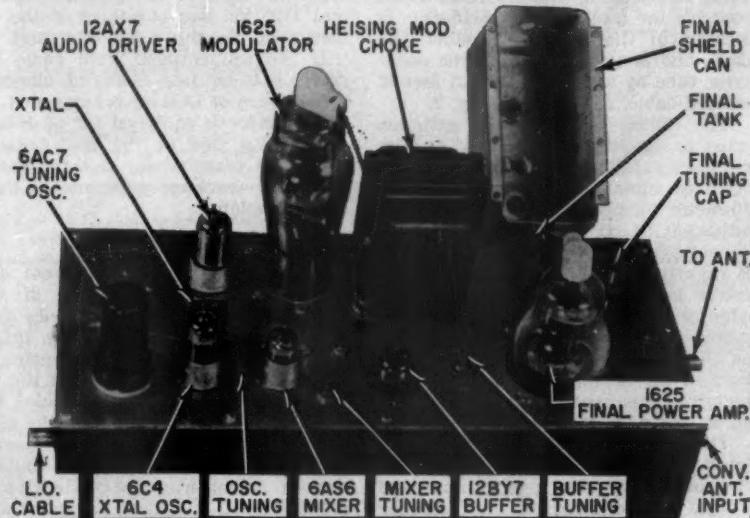
Some precautions are necessary. The grid or cathode video-driving signal must be removed while making the check. Improper CRT electrode voltages due to other causes must be eliminated during the test. The capacitor (in capacitively coupled sets) may be leaky, for example. It can be disconnected if electrode voltages at grid and cathode are not normal with video signal absent or nearly so—switch to a blank channel momentarily. Similarly, in a direct-coupled job an upset or improper electrode voltage on the video amplifier will yield an erroneous test. You would have to correct this before proceeding with the grid-current check.

(Continued on page 139)



AUTOMATIC TRACKING MOBILE SYSTEM

The transmitter, shown below, may be located in the trunk of the car.



By HENRY S. KEEN, W2CTK

Albion Instruments Lab.
Div. of Cutler-Hammer, Inc.
Mineola, N. Y.

Novel 10-meter ham rig uses v.f.o. system in which both transmitter and receiver are tuned by means of a single knob.

OPERATING techniques at the amateur radio station have changed since the general acceptance of the v.f.o. No longer does the ham call "CQ" and then start tuning from the nearest edge of the band. Now he first listens on and near his own transmitter frequency. The result has been a higher percentage of contacts from shorter calls and the pile-up on the band edges has been reduced.

In order for the relatively low-powered mobile station, with its necessarily modest antenna system, to survive among the high-powered denizens of the megacycles, maximum flexibility and every possible operating advantage must be provided. A fairly recent innovation, which has proven ideal for this purpose, is the automatic-tracking v.f.o. system.

The design to be described was evolved with full recognition of the limitations that the safe handling of a car can place upon even the most talented devotees of the sport. The principles may be applied with equally happy results, however, to the design of the home station.

The tracking of the transmitter with the receiver may be accomplished by either mechanical or electrical means. The electrical method can easily give

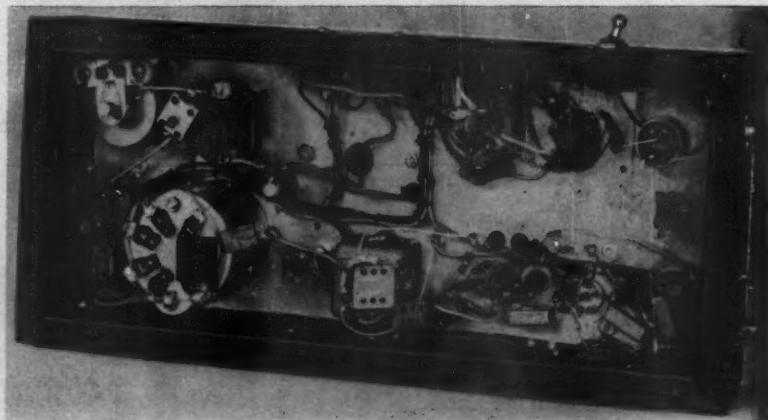
zero-beat frequency coincidence and is therefore to be preferred.

If the maximum benefits of the system are to be realized, however, certain limitations must be understood. It can be seen that when the frequency of the transmitter coincides with that of the received signal, it will be most unwise to call foreign stations operating out of the U. S. phone bands. There may also be complications in calling

"CQ" with this system, if its operation is not fully understood, for if the operator should tune around for an answer to his call the transmitter frequency will be shifted accordingly and the answering station may miss his second transmission altogether. It will be shown that these problems can be eliminated by proper equipment design and valid operating techniques.

The basic form of the electrical

The bottom view of the transmitter portion of the automatic tracking mobile system.



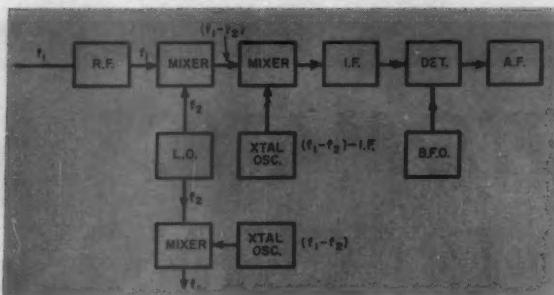


Fig. 1. Block diagram illustrating double conversion tracking.

tracking system is shown in the block diagram of Fig. 3. It will be seen that combining the frequency of the tuned local oscillator with that of the b.f.o. or i.f. oscillator will produce a signal whose frequency coincides with that of the received signal. This signal can then be used to excite the transmitter.

The problem of spurious image signals must be considered with this arrangement because of the relatively low intermediate frequency that is used in most receivers.

A simpler method, which eliminates this problem, uses double conversion in the front end, as shown in Fig. 1. When transmitting, one simply substitutes a different crystal-controlled oscillator, whose frequency differs from that of the receiver's crystal oscillator by the i.f. frequency. This solution buys us two additional advantages:

1. The frequencies that are combined to excite the transmitter will both be high enough to solve the image problem.

2. The variable-frequency local oscillator can be designed for a considerably lower frequency than the unit of Fig. 3. This gives improved frequency stability to both transmitted and received signals. Use of a lower frequency in the tuned oscillator allows the application of the remotely tuned

version of the Clapp oscillator circuit. In this system the oscillator tube is located on the transmitter chassis which is placed in the trunk of the car while the remotely tuned circuit which controls the frequency of oscillation is located in the converter, under the dash, and is separated from the oscillator tube by approximately 15 feet of coaxial cable, as shown in Fig. 2.

The tuning range of the oscillator must be chosen so that none of its harmonics can fall on the frequency of the received signal. For operation in the 10-meter phone band, the oscillator is adjusted by trimming and padding capacitors, so that its lowest frequency is slightly above 7125 kc. when the receiver is tuned to the low-frequency edge of the band. As the fourth harmonic always moves four times as fast as the fundamental when the dial is turned, the harmonic must always be higher in frequency than the received signal and no beat signal can be caused.

The dynamic stability of this oscillator under vibration, due to the motion of the car, was greatly improved by the unique design of the oscillator coil. This inductor was wound on a ferrite toroid coil form which gives extremely high "Q" and provides ease of mounting. See Fig. 4. No shielding is required when one of these forms is used as the field is almost entirely confined in the toroid form.¹

An earlier design used a 30-turn section of standard *B & W* #3016 coil stock (1" diameter, 32 turns-per-inch) mounted in a shield can. The series capacitor (C_s in Fig. 5) was a 50 μfd . air padder set at approximately half capacitance. Some difficulty was experienced in mounting this coil in a sufficiently rigid manner to prevent frequency modulation from accompanying the mechanical vibration that comes with driving the car. The ferrite toroidal coil, in addition to showing a measured "Q" of over 600, seemed impervious to vibration of this sort.

The crystal-controlled oscillator is an overtone type, using a readily available surplus crystal. An oscillator and multiplier combination should not be considered in a receiver because of the possibility of spurious responses caused by beats between fundamentals or unnecessary harmonics with other signals in the converter.

The frequencies of the transmitter and receiver crystal oscillators are chosen so that they differ by the fre-

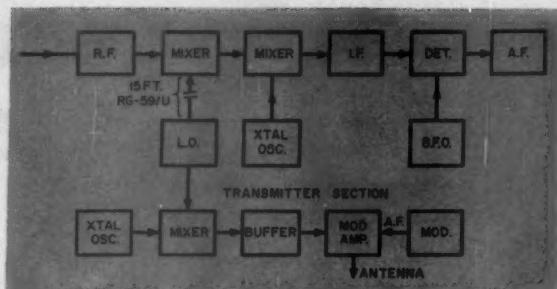


Fig. 2. Diagram of the complete system as described in article.

quency of the i.f. The exact frequencies vary with the selected local oscillator tuning range. Suggested frequencies for the 10-meter band are 7125 kc. for the transmitter crystal and 7125 kc. less one-third of the i.f. frequency for the receiver crystal.

If the conventional auto radio receiver is to be used as the i.f. channel, a frequency of 1200 kc. is suggested. If this receiver is equipped for push-button tuning, one of the push-buttons should be reserved for this frequency after the tracking adjustments have been completed.

Operating Procedure

In order to positively prevent any illegal transmissions outside of the U. S. phone bands, the frequency limits of the local oscillator are intentionally fixed when the converter is tuned up. The tuning range of the receiver, however, can be extended beyond these limits by detuning the auto radio receiver from its nominal operating frequency to which the push-button was set. In this way, one can listen outside of the U. S. phone band without any danger of transmitting there, as a properly adjusted transmitter just cannot be tuned to these frequencies.

After calling "CQ," the technique is much the same. One tunes around for a reply by tuning the auto radio only. When the contact has been finished, a touch of the push-button restores the tracking feature of the system.

Design Considerations

The block diagram, Fig. 2, shows that separate overtone crystal oscillators are used for transmit and receive. Change-over is accomplished by merely switching plate supply leads.

The converter uses four tubes, as shown in the schematic of Fig. 5. The tuned circuit of the local oscillator is also located on the converter chassis and is tuned by a section of the same three-gang tuning capacitor that tunes the r.f. amplifier and the first mixer grid circuit.

When the bandspread is controlled by a combination of series-padder and shunt-trimmer capacitors, as in this circuit, the three-gang tuning capaci-

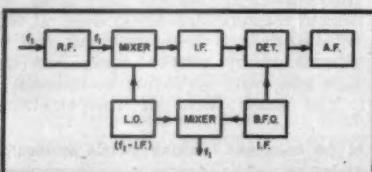
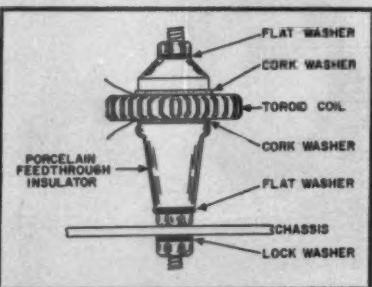
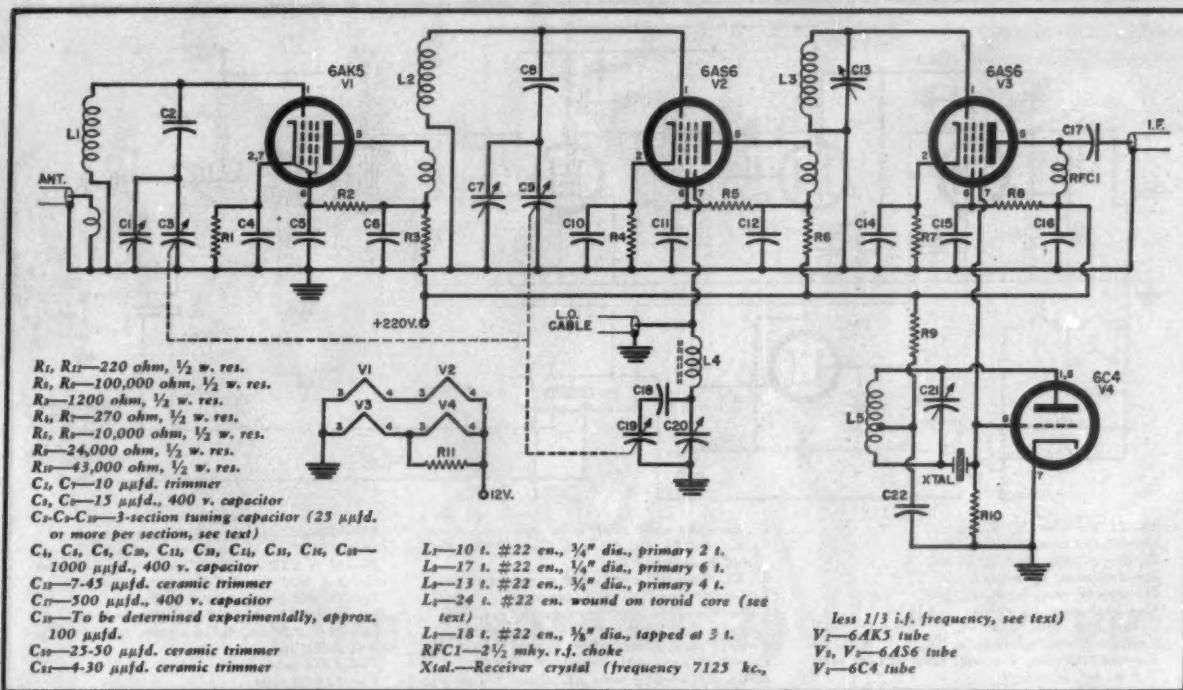


Fig. 3. Here is a basic tracking system using single frequency conversion.

Fig. 4. Toroid coil mounting arrangement.



¹ The toroid coil form used in this oscillator is made by General Ceramics Corp., Kenesey, N. J. and is designated as the 624-2 (Q-2). Because these parts are not generally available at retail, arrangements have been made with Arrow Electronics, 525 Jericho Turnpike, Mineola, N. Y. to stock them. Price per unit is \$1.10 net.



tor is in no way critical. The author once built a very successful 20-meter receiver around a three-section broadcast tuning capacitor which spread the phone band over the entire dial. Almost any available three-gang tuning capacitor, having 25 μ fd. or more capacity per section, can be used successfully in this application.

An audio stage was also mounted on the converter chassis so that the low-level stages of the modulator would be isolated from the strong r.f. fields of the transmitter. The wiring in both units is strictly point-to-point. It doesn't look very fancy, but it works and that's what matters.

The r.f. section of the transmitter

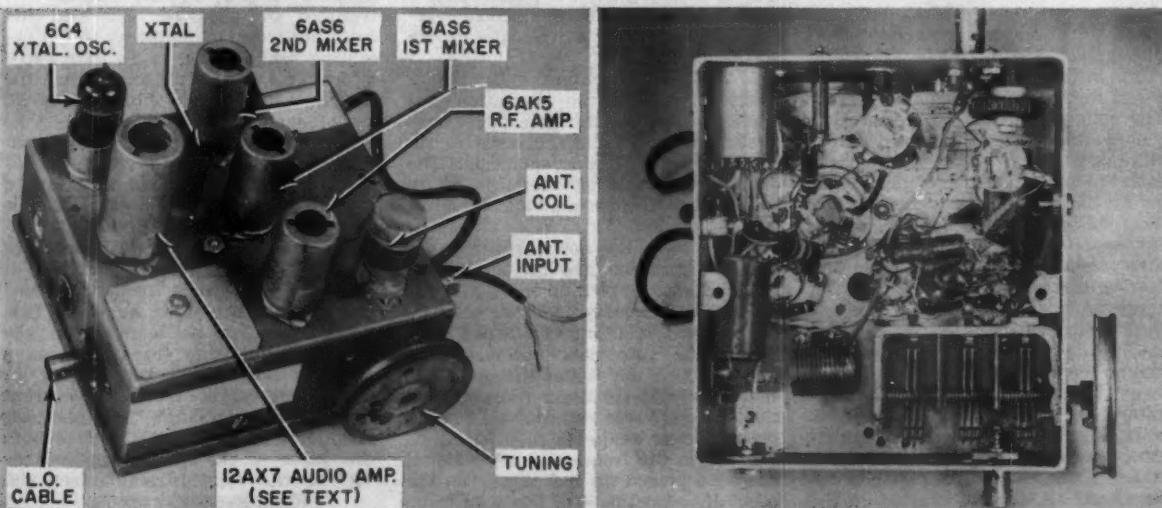
(Fig. 6) consists of the tuned local oscillator, an overtone-crystal oscillator, mixer stage, buffer, and the modulated r.f. amplifier. The audio system will not be described as each builder will probably base his design on the parts he happens to have on hand. In the transmitter described, the author used the reference-shift modulator circuit, developed by Dale Hileman, K6DDV ("CQ", June 1956), which was found to be very satisfactory since it gives more audio output with fewer parts than do most modulator systems.

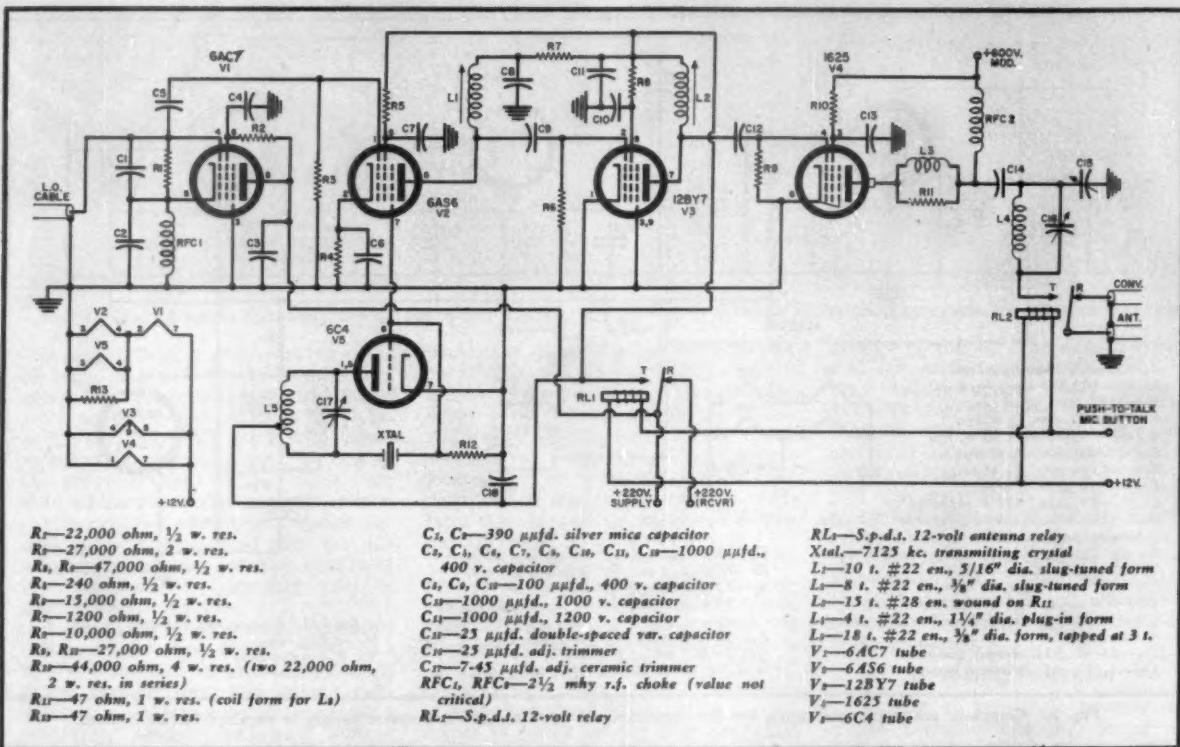
The r.f. circuits are broad-banded by using slug-tuned coils, with all of the shunt capacitance being supplied by the wiring and the input and output

capacitance of the tubes. The buffer stage provides adequate excitation to the final r.f. amplifier over the entire 10-meter band.

The plate circuit of the final amplifier is broad-banded by using an "L" network, combined with a coaxial cable quarter-wavelength transformer as the antenna feeder. The feeder is 5'4" long and is made up of three parallel sections of RG-55/U cable. All shields are grounded at both ends. The antenna itself is a 96" whip. This system, which was introduced to the author by W2OWO, provides good loading of the final amplifier over the entire 10-meter phone band without requiring any re-tuning of the circuit.

Dial cord of converter (below) runs from pulley to knob mounted on dash in hole originally intended for cigarette lighter.





$R_1 = 22,000 \text{ ohm}, \frac{1}{2} \text{ w. res.}$
 $R_2 = 27,000 \text{ ohm}, 2 \text{ w. res.}$
 $R_3, R_4 = 47,000 \text{ ohm}, \frac{1}{2} \text{ w. res.}$
 $R_5 = 240 \text{ ohm}, \frac{1}{2} \text{ w. res.}$
 $R_6 = 15,000 \text{ ohm}, \frac{1}{2} \text{ w. res.}$
 $R_7 = 1200 \text{ ohm}, \frac{1}{2} \text{ w. res.}$
 $R_8 = 10,000 \text{ ohm}, \frac{1}{2} \text{ w. res.}$
 $R_9, R_{10} = 27,000 \text{ ohm}, \frac{1}{2} \text{ w. res.}$
 $R_{11} = 44,000 \text{ ohm}, 4 \text{ w. res. (two } 22,000 \text{ ohm, } 2 \text{ w. res. in series)}$
 $R_{12} = 47 \text{ ohm, 1 w. res. (coil form for } L_2)$
 $R_{13} = 47 \text{ ohm, 1 w. res.}$

$C_1, C_2 = 390 \mu\text{fd. silver mica capacitor}$
 $C_3, C_4, C_5, C_7, C_8, C_{10}, C_{11} = 1000 \mu\text{fd., } 400 \text{ v. capacitor}$
 $C_6, C_9 = 100 \mu\text{fd., } 400 \text{ v. capacitor}$
 $C_{12} = 1000 \mu\text{fd., } 1000 \text{ v. capacitor}$
 $C_{13} = 1000 \mu\text{fd., } 1200 \text{ v. capacitor}$
 $C_{14} = 25 \mu\text{fd. double-spaced var. capacitor}$
 $C_{15} = 25 \mu\text{fd. adj. trimmer}$
 $C_{16} = 7-45 \mu\text{fd.}$
 $RFC_1, RFC_2 = 2\frac{1}{2} \text{ mhy r.f. choke (value not critical)}$
 $RL_1 = S.p.d.t. 12-volt relay$
 $RL_2 = S.p.d.t. 12-volt relay$

$L_1 = 10 \text{ t. } \#22 \text{ en., } 5/16" \text{ dia. slug-tuned form}$
 $L_2 = 8 \text{ t. } \#22 \text{ en., } \frac{3}{8}" \text{ dia. slug-tuned form}$
 $L_3 = 15 \text{ t. } \#22 \text{ en., wound on } R_1$
 $L_4 = 4 \text{ t. } \#22 \text{ en., } 1\frac{1}{4}" \text{ dia. plug-in form}$
 $L_5 = 18 \text{ t. } \#22 \text{ en., } \frac{3}{8}" \text{ dia. form, tapped at 3 t.}$
 $V_1 = 6AC7 \text{ tube}$
 $V_2 = 6AS6 \text{ tube}$
 $V_3 = 12BY7 \text{ tube}$
 $V_4 = 1625 \text{ tube}$
 $V_5 = 6C4 \text{ tube}$

Fig. 8. Schematic diagram and parts list for the transmitter. An auxiliary "B+" supply is required for the mobile rig.

A small refinement was added, in the form of a trimmer capacitor across the "L" network inductor. When properly adjusted, this combination acts as a parallel-tuned trap to the second harmonics of the transmitted signal and makes life on Channel 2 more pleasant for those within range of your rig. This adjustment is best made while actually watching Channel 2 on your TV receiver and should be followed up by an adjustment check of the plate-tuning capacitor.

Tuning Up

In the construction process, all coils are first trimmed with the aid of a grid-dip oscillator (with all tubes in their sockets) and are later peaked more accurately under actual signal conditions. If the builder is equipped to check out all coils in this way, he can use almost any coil forms he has available.

The coils in the transmitter section are slug-tuned and should be given a preliminary check with a grid-dip oscillator to make sure that they resonate at the desired frequencies. The tuning slugs are given a final adjustment under actual load conditions to insure maximum grid current on the following stage. The writer measured the grid voltage developed on the following grids, which is essentially the same, by de-coupling the lead capacitance of the v.t.v.m. through a 1 meg., $\frac{1}{2}$ -watt resistor. In this way the capacitance of the leads will not affect the tuning. The transmitter adjustments are, of course, made at some frequency near the center of the 10-meter band. A drop of cement on the

threads of the slug adjustment screws will then maintain these adjustments under road vibration.

The transmitter and receiver are adjusted for zero-beat tracking with the aid of a heterodyne frequency meter, such as the BC-221. If one of these units is not available, the adjustment can be made with a simple regenerative receiver or with a pair of phones in the plate circuit of the grid-dip oscillator. The procedure is as follows:

1. The tuned local oscillator will first be set on some frequency known to be within its intended tuning range. The two overtone-crystal oscillators will be individually checked for operation by listening to their signals on the shack receiver whose "transmit-receive" switch is set at the appropriate position.

2. With the switch in the "transmit" position, tune in the excitation frequency signal on the heterodyne frequency meter or the regenerative receiver in its oscillating condition. The dial of the frequency meter is set to zero-beat with this signal and then left in this position.

3. The switch is now thrown to the "receive" position and the mobile receiver is used to pick up the signal put out by the frequency meter or oscillating receiver. This signal is tuned in by tuning the auto radio receiver only. Do not touch the dial of the converter as this would shift the frequency of the local oscillator and you will have to start all over again.

4. When the frequency meter signal has been picked up and tuned "on the nose" by adjustment of the auto radio

dial, set one of the push-buttons permanently to this frequency.

5. Re-tune the converter to some other frequency. Set switch to "transmit" position and again tune in the excitation frequency signal on the frequency meter as before. This time when the switch is thrown back to the "receive" position, the frequency meter signal should already be zero-beat without further adjustment. If it is not, something is wrong and the frequencies of each oscillator should be carefully re-checked to be certain that one of them is not mis-tuned.

After these tracking adjustments have been made and checked, the individual tuned circuits should be trimmed and adjusted. The first and most important adjustment is the operating range of the tuned local oscillator. This should be set so that the receiver will tune to within 20 or 25 kc. of each end of the band but no closer. This is done by progressive adjustments of the series padder (C_{14}) for bandspread and the shunt trimmer (C_{15}) for locating the tuning range. Be sure that you double check these adjustments before going on the air with anything but a dummy antenna!

A word of warning about the toroid coil forms: Care must be taken that these cores are not exposed to any strong magnetizing force, such as a strongly magnetized screwdriver or the passing of a strong d.c. current through the winding. The resulting residual magnetism will change both the value of the inductance and the "Q" of the coil. A magnetized coil

(Continued on page 142)

The Approach to Hi-Fi Service

If you appreciate its difference from other forms of electronic service, this is a rewarding field.

THE GENERAL public's interest in high-fidelity sound reproduction, involving the purchase of large amounts of hi-fi equipment over the past several years, has resulted by this time in a great need for competent service. Much of the equipment now gives far from true high-fidelity reproduction and—at best—is in need of considerable adjustment, balancing, tube changing, and other routine maintenance to restore it to its best operating potential. However, it is frequently difficult for the average owner to obtain the proper maintenance.

Because there is a constantly increasing need for this type of service, the door is open to the enterprising service dealer and technician. The audiophile, who generally spends a considerable sum of money assembling a system which he feels will give him the best sound reproduction obtainable within his budget, generally realizes that the type of service he needs to keep his equipment in its best operating condition cannot be cheap.

However, the technician must be adequately prepared before he attempts to tackle high-fidelity servicing and he should not undertake to do high-fidelity work without some orientation and preparation.

Servicing Techniques

The radio and TV service technician is, of course, basically equipped by his training and experience to repair most failures of high-fidelity equipment, but there are some extremely important differences in approach and technique that he must understand if he is to

be successful in audio work. In repairing failures in high-fidelity equipment, the basic procedures in restoring equipment to its original operating condition are the same as for any other type of servicing. These are:

1. Determine the specific complaint or failure by listening to the system under normal conditions.

2. Locate the section or unit of the system in which the failure has occurred (for example, by use of signal-tracing techniques).

3. In the defective unit, determine the specific component or circuit failure which is the cause of the trouble, and repair it.

4. After the major repair has been made, recheck the system to see that it is operating properly.

When these procedures are applied to the servicing of high-fidelity systems, the most important differences are that more care must be taken in performing tests and measurements on the system and generally more tests and measurements are performed than on other types of equipment. See Fig. 1.

Some systems can be quite complex, with a number of different input units (such as tape recorders, phonographs, TV sound, microphones, etc.), remotely located preamplifier and control units, and multiple loudspeaker arrangements in various locations throughout the house or apartment. Of course, most systems are not this complicated but even the simplest setup can give trouble to the technician who is not on his toes.

In servicing any system, always pay attention to the details of that system.

Always note the settings of the operating controls—volume controls should be kept at their normal settings, while tone controls should generally be set for flat response when making any measurements (other than tests of the controls themselves). Try to use the system itself as an aid, manipulating the different switches and controls to determine more closely the location of the failure. If attention is paid to points such as these, the technician will find that even complex systems are often resolved into simple elements.

Reproduction Criteria

There is a great difference between high-fidelity reproduction and that which is obtained from the average radio, phonograph, or TV receiver. In the latter types of equipment, many compromises are made in the quality of the reproduced sound. For example, in AM broadcasting the frequency response is limited by the bandwidth of the channel and the response of the receiver circuits. In TV receivers, the sound is transmitted by frequency-modulation of a carrier signal, but potential fidelity is destroyed in most receivers by a poor loudspeaker system and inadequate audio-amplifier circuits.

The primary purpose of high-fidelity reproduction is to duplicate the original sound for the listeners as nearly as possible. Any differences between the original and the reproduced sound, broadly speaking, are *distortions* which must be kept to negligible proportions for the reproduction to be good. Except for outright failures, most of the complaints the technician will receive

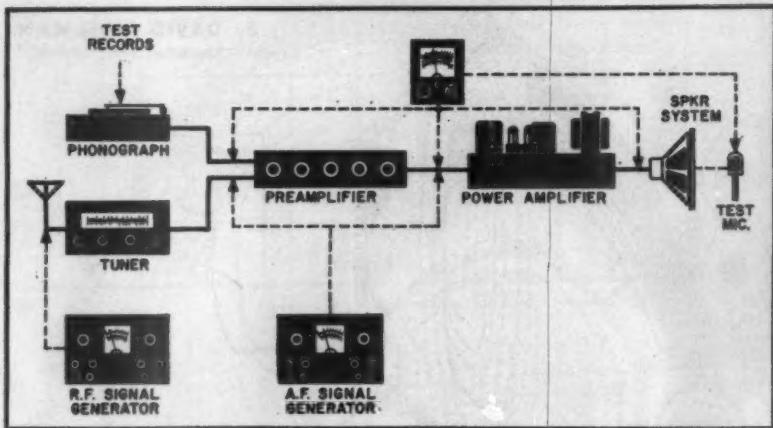


Fig. 1. Points of signal injection and measurement for various audio tests.

about the systems he is called upon to repair will involve excessive distortion in one form or another. He should, therefore, know something about these distortions in order to be able to discuss them intelligently, understand what types of failures can be causing them, and use this information to aid him in servicing the system.

The major forms of distortion that are likely to occur in the reproduction of sound are:

1. Frequency-response distortion. This is the departure of the system from a flat over-all input-to-output frequency response. Completely undistorted reproduction of all the frequencies that it is desired to reproduce is extremely difficult; therefore some reasonable compromises may be made between the requirements of perfect fidelity of reproduction and the limitations of practical systems. The major limitations of frequency response are in the electro-acoustic sections of the system (such as the phonograph cartridge or loudspeaker), where reproduction of both the extremely high and extremely low frequencies is very difficult. When a system that has been operating satisfactorily develops severe frequency-response distortion, try to localize the source of the distortion by use of the system's switches and controls. In the amplifier, it may be due to a component failure in the feedback or tone-control circuits; in the phonograph, it may be due to a worn stylus or a component failure in the preamplifier-equalizer circuit; in a multiple loudspeaker system, it may be due to a misadjustment of the level control of one of the loudspeakers.

2. Reproduction noise. The noise introduced by the system itself is generally the most obvious form of distortion and must be kept as low as possible, both because it limits the dynamic range and because of its disagreeable quality. The major sources of noise are usually surface noise in records and static in AM broadcasting; the other parts of a good high-fidelity system should be virtually free from noise. If the noise level of the system has increased appreciably, first determine

the nature of the noise by listening to the system. If the noise is hum, check for open grounds in the system wiring, for tube heater-to-cathode leakages, and for misadjustment of the hum-balancing control. If it is noise other than hum, check for defective or microphonic tubes in the amplifiers, noisy potentiometers, insufficient tuner sensitivity for complete limiting, etc.

3. Harmonic and intermodulation distortions. These distortions occur whenever any part of the system is not perfectly linear (that is, the output is not perfectly proportional to the input signal for all frequencies). This non-linearity causes the introduction into the signal of frequencies that were not present in the original sound. Spurious harmonics are created (harmonic distortion) and the high frequencies in the signal are modulated by the low-frequency components (intermodulation distortion). These types of distortion can be kept extremely low in amplifiers by the use of negative feedback; however, the non-linear distortion in the loudspeaker is difficult to control and is, in fact, even extremely difficult to measure.

When the distortion increases greatly in a system that has been operating satisfactorily, the most likely cause of the trouble is a component failure or imbalance in one of the amplifiers; this may cause overloading of one of the stages, shift the operating characteristic of one of the tubes, or cause improper feedback.

4. Flutter and wow. When the system is set up to reproduce sound from disc or tape recordings, the frequency of the output sound is determined by the relative speeds of the recording and reproducing drive mechanisms. Very good machines are generally used in recording but there are often changes in the speed of the reproducing turntables. When a playback turntable does not run at absolutely constant speed, there is a *flutter* (rapid variation) or a *wow* (slow variation) in the frequency of the reproduced sound which is quite annoying to the listener. Wow and flutter (provided that they are not due to a defective record or tape) generally



Measuring phonograph stylus pressure.

develop or become severe in phonographs and tape recorders after they have been in the system for some time and are usually due to eccentricity, flat spots, slippery or uneven surfaces on rubber wheels, belts, or pressure rollers.

5. Transient distortion. Since most of the sounds of speech and music occur in bursts of short duration, the sound reproducing system must be able to respond properly to these transient tones as well as it does to steady tones. Very often two systems with virtually identical steady-state characteristics are found to sound quite different when they reproduce speech or music. This difference can generally be attributed to differences in transient response.

A poor transient response generally takes the form of undamped vibrations caused by resonances or mechanical inertia. In general, the system should have a smooth over-all frequency-response curve with a minimum number of peaks and dips in the curve for good reproduction of transients—a factor that is especially critical in the pickup cartridge and the loudspeaker. The transient response of a system is inherent in its design and transient distortion is generally not a primary cause of failure. A failure which affects the transient response adversely almost always will show up as an increase in some other form of distortion: when this other distortion is corrected, the transient distortion will also be corrected.

6. Insufficient power output and insufficient gain or sensitivity. Even when a system is free from all the other forms of distortion, if it does not have sufficient amplification nor provide a high enough sound level, it will not reproduce the original sound accurately. The system must be able to reproduce in the listening room a loudness level, without overloading, which the listener can at least relate to the original sound; it must also be able to reproduce both the normal and the peak loudness levels. In systems which have previously been operating satisfactorily, but which have suddenly or gradually been decreasing in gain or output level, the most likely cause of the failure is a



Much audio test gear is conventional.



Set-up for over-all performance test.

tube, component deterioration, or failure in one of the amplifiers.

In a good high-fidelity system, the distortions just discussed are kept to low values by proper design of individual components and also by combining the different units in the system properly. The latter would include giving careful consideration to such factors as signal levels and impedance levels. A summary list of various performance characteristics, including common distortions, appears in Table 1, along with arbitrary limits.

In connection with the limits given, it should be noted that there is considerable difference of opinion as to where the lines should actually be drawn. This is partly related to the fact that there are varying techniques for taking the measurements involved, with different methods giving different readings. However, outright defectiveness or serious misadjustment will generally produce such substantial changes in these measurements that the table, however arbitrary, can be useful if applied with caution to practical service problems.

In general, transducers such as microphones, phonograph pickups, and speakers or speaker systems, will fall considerably short of the specifications that may be more easily met by amplifiers, preamplifiers, and tuners. Price range of the components involved and manufacturers' ratings afford some guidance as to whether any unit should be expected to deliver "good" or "acceptable" reproduction, but neither of these criteria should be regarded as an absolute in all cases.

In this connection, many systems will be encountered that never have at any time met the requirements of true hi-fi performance and cannot be made to do so by simple repair or adjustment or by any measures short of redesign or replacement. This will be especially true of some of the popular-priced units. With many of these, the technician is faced with a delicate problem. If he is not familiar with the units involved and their limitations, he must often rely on the judgment of the user to decide whether a particular system

with" his system. Many times owners who complain about distortion which they say was not present before are actually just becoming aware of something that was there from the beginning. It may therefore help to know how long the system has been in use. If an audiophile has been happy with his hi-fi setup, say, for a couple of years, and suddenly hears a change about which he is quite displeased and reasonably definite, the chances are that something has really gone wrong. In any event, the service technician must be able to evaluate the owner as well as the equipment. This is particularly important when the question arises as to whether correction of existing equipment should be undertaken or instead the replacement of certain units should be recommended. The audiophile's increasing discrimination is a significant factor.

Test Equipment

One thing that has made many technicians hesitate over embarking on hi-fi service is the presumed high cost of the full complement of required test equipment. It is true that complete and accurate determinations of system per-

(Continued on page 111)

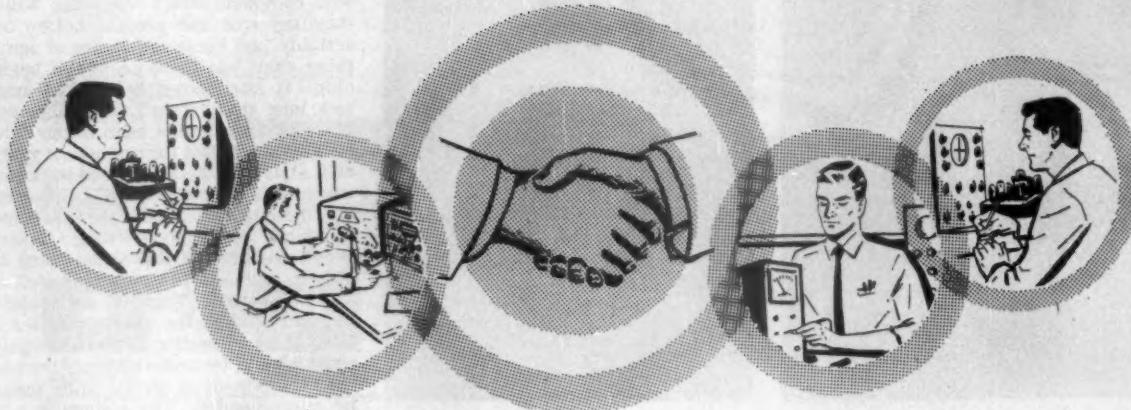
PERFORMANCE CHARACTERISTIC BEING MEASURED	TYPE OF SIGNAL WITH WHICH MEASURED	LIMITS	
		GOOD REPRODUCTION	ACCEPTABLE REPRODUCTION
Frequency response	Steady sine wave	20-20,000 cps (± 1 db)	40-14,000 cps (± 1 db)
Noise level	Zero input	-60 db below full output	-55 db below full output
Intermodulation distortion (amplifier alone)	Sum of high-frequency and low-frequency steady sine waves	2%	5%
Harmonic distortion (amplifier alone)	Steady sine wave	2% total harmonics	3.5% total harmonics
Transient response	Square wave	No Set Standards	
Wow and flutter	Steady sine wave	0.2%	1%

Table 1. Important characteristics of audio equipment with suggested limits.

Table 2. Equipment used in audio service. Much of it is already in the shop.

ELECTRONIC TEST EQUIPMENT	* Variable-frequency sine-wave and square-wave oscillator Audio-frequency vacuum-tube voltmeter * Oscilloscope Intermodulation distortion analyzer FM sweep generator * Voltmeter
OPTIONAL ELECTRONIC TEST EQUIPMENT	Harmonic distortion and noise meter Wow and flutter meter Audio sweep generator
ACOUSTIC AND ELECTROMECHANICAL TEST EQUIPMENT	* Standard test records * Stroboscope disc Test microphone
ACCESSORY EQUIPMENT	* Headphones Good high-fidelity amplifier Good FM tuner High-quality three-speed transcription turntable with transcription arm, plus magnetic and piezoelectric cartridges Full-range loudspeaker or loudspeaker system in good enclosure

* Minimum equipment required



"Collective Security" for Service

A fresh viewpoint on problems, new stimulus, and confidence are the fruits of association activity.

WHAT HAVE I to gain by joining an association?" In every town where a group of service dealers have joined together to build an association, that is the No. 1 question they have to answer when they solicit new members. The reply is not an easy one.

The most commonplace and widely used reason—that the benefits a dealer will gain from association membership will be in direct proportion to what he contributes to it—is too much of a generalization to register with a lot of shop owners. It misses the mark because the average dealer carved his business out of nothing and did it without outside co-operation or help. He is a rugged individualist because he had to be.

In many ways, handling consumer service is a lonely business. Service is a product the public does not want to buy. When it is needed it usually is bought grudgingly. Customers frequently pay service bills with the thinly veiled attitude that they are handing their money to a robber. That sort of approach jars a technician's self-respect.

It seems that a good service dealer must be an unusual combination of introvert and extrovert. On the one hand, he must be able to concentrate his thoughts on the technical aspects of his business. On the other, he must be an affable fellow, with a ready smile and a genial manner. He must be an avid student in a technical field that is rapidly expanding its boundaries of knowledge, while pleasing a public that is blissfully ignorant of the technical vagaries of the products it uses.

Where does an association fit into this service dealer's life?

The electronic service business of today is unlike any other type of independent business. It is a combination of retail store and technical laboratory. It must be able to sell time and knowledge at a profit, for time and knowledge are the main products it has to sell.

It functions in a constantly changing field. While its bread-and-butter business has been consumer television service, new products and the broadening public acceptance of old products keep opening up new avenues of opportunity.

Television service, the bread-and-butter part of the business for many dealers, is under constant pressure from several directions. Owner self-servicing of sets is lapping up an increasing percentage of the replacement tube business. Competition in the sale of new sets is leading set manufacturers to offer free service on their brands. Gyp artists, who are able to operate freely in towns that do not have aggressive service associations, continue to keep a cloud of set-owner suspicion over the honesty and integrity of all independent service shops.

The first benefit a service dealer gains from association membership is a better understanding of what is happening in his industry. Through his contacts with other dealers in the association he will keep informed on developments that have an important, and sometimes vital, bearing on his business.

It is on record that, in many cities where effective associations are operating, they have succeeded in driving

out unscrupulous dealers who caused the public to be suspicious of all independent service shops in their communities. These campaigns to clean up the service industry were successful only because a majority of the honest, ethical dealers thought enough of their businesses to be willing to fight to protect them.

The second benefit a dealer gains is a higher respect for the work he is doing and the business he is in. As one dealer so aptly put it, "I did not know there were so many high-caliber men in the service business until I joined our local service association. Before I became a member, I was so wrapped up in my business that I did not pay any attention to my competitors. I have been surprised at the number of my problems I have found answers for just by talking them over with fellow members in the association."

Another dealer, who encourages his technicians to attend all of the technical and social gatherings of his association, said he has found that the fellowship of these affairs boosts the morale of his men. In commenting on it he said, "A technician takes a terrific pounding from customers day after day. Every set owner presents a different problem. Some of them are very unreasonable and make a man feel like a heel when he presents the bill for payment. But when the boys get together with other technicians and they swap experiences, it adds to their self-respect. They even find humor in their experiences with the toughest customers."

(Continued on page 151)

By BOB ELDRIDGE

Key Test Points in TV Sets

ALTHOUGH not marked with large signposts, there are several places in every TV set that are gratifyingly useful as initial test points. Once the fault has been observed, the function of one or more specific sections of the TV receiver falls under suspicion. The methodical technician tends to look for one or more corresponding key points in the circuit to which he can go immediately for information that will start narrowing down possibilities quickly.

The point he chooses depends on what he sees and how he interprets this information. Here is one plan of action worked out on a "symptom" basis.

No Picture, No Sound

When the raster is normal but devoid of any picture and the sound is conspicuous by its absence as well, the most convenient point to start the hunt is at the grid of the video amplifier tube (or, if there are two stages of video, the grid of the first video amplifier).

This is easily located in an unfamiliar chassis by the cluster of peaking coils invariably found there and by the low-wattage resistor (usually about 3300 to 5600 ohms) used in the video-detector load. Any of the four spots indicated in the diagram of Fig. 1 is suitable for connection of a v.t.v.m. or oscilloscope—just clip on to whichever tag is most easily accessible.

With the set tuned to a working channel and the antenna connected, a negative voltage will appear at any of these test points if the signal is being passed through the i.f. strip and rectified by the video detector.

The most logical point to choose, if easy to get at, is the output electrode of the detector. The reason? If no sig-

nal is found here, the meter can be switched to "Ohms," and one continuity check (with the set off, of course)

EDITOR'S NOTE: Are you a "system" man on the service bench or are you the "inspiration" type? Do you have an approach to each job based on the symptoms or do you rely on random judgment to lead you to quick revelation—when it does? The author, obviously of methodical temperament, has worked out his own technique for using certain "jumping-off" spots based on the defect. His is not the only such approach possible. However, if you are still fumbling for a fast, workable method—or even if you have found one—take advantage of his experience and ability to try his "Key system."

will prove out all the peaking coils and the video-detector load resistor simultaneously.

The voltage appearing at this point will vary from set to set, depending mainly on the nature of the a.g.c. system. On a set with keyed or gated a.g.c., the voltage is normally between 1.5 and 3 volts over a wide range of signal strengths. If a simpler system is in use, several volts will appear on a strong signal.

If you are checking with the oscilloscope, the sweep should be set at 7875 cps or 30 cps and the vertical gain set to give a readable waveform with about 5 volts peak-to-peak signal. This point is the earliest spot in the video chain where a rectified signal is present, so it is not necessary to use an r.f. probe on the v.t.v.m. or oscilloscope.

Is the Oscillator OK?

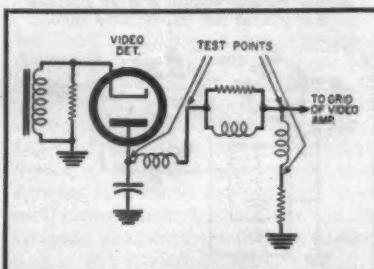
If it is suspected that the local oscillator in the tuner may not be working,

the test point here is the grid of the oscillator tube. It may be necessary to use an adapter socket to make this measurement, if the tuner is not constructed to give easy access to this tube-socket terminal.

If an adapter is not available and the base fitting for the tube shield makes it impossible to get at the pins from above even with the tube eased partly out of its socket, a short piece of thin, insulated wire can be attached to the oscillator grid pin before reinserting the tube in its socket and the other end of the wire used as a test point. This is particularly useful where it is felt that the adapter may itself be the cause of improper stage operation.

Any conventional oscillator develops negative voltage at the grid and absence of this potential, or existence of positive potential, is proof that the oscillator is not working. Do not confuse the oscillator and mixer sections

Fig. 1. Test points in the load of the video detector. See text for choice.



of the converter during this procedure.

The Video Amplifier

If the signal is present at the video-amplifier grid but appears to have bogged down right there, the key point of the video-amplifier stage is the cathode (assuming this electrode is not grounded).

A measurement at this point, with the v.t.v.m. set for positive volts, will show whether or not the tube is passing current. If the contrast control, shown in Fig. 2, is set to a known value (a multiple of 10 ohms makes it easy for mental arithmetic), a simple calculation using Ohm's Law will indicate the amount of cathode current passing. After a little practice, very little actual calculation is necessary. It is easy to memorize a couple of basic facts and work from there by comparison. Remember that across 100 ohms, 10 volts mean 100 milliamperes are flowing and across 1000 ohms, 10 volts mean 10 milliamperes are flowing.

Sound Troubles

The sound section can be conveniently split in half at the output of the FM detector. In the circuit shown in Fig. 3, the sound carrier produces a d.c. bias across the 22,000-ohm resistor

which forms the ratio-detector load. This point is easy to locate in an unfamiliar chassis because there is always a relatively large filter capacitor, usually between 2 and 10 μ fd., across the load.

The presence of a few volts at this point (use the markings on the capacitor to establish the polarity), varying as the fine tuning control is moved, is a good indication that the sound i.f. is passing a signal. The actual voltage varies widely from one model to another, being anything from 2 volts in one set to maybe 40 volts in another.

There is no really well-established key point in the audio amplifier, but there is one fact which merits a lot of emphasis. The operating grid bias of the sound-output tube is the voltage existing between cathode and grid. This may seem rather self-evident, but many technicians, influenced by radio technique, sometimes overlook the fact that, in TV circuits, neither the grid nor the cathode is necessarily at ground potential. Certainly the key to the correct operation of the audio-output tube shown in Fig. 4 is the voltage on the grid, but this voltage only means something when compared with the voltage on the cathode.

The obvious way to measure bias

would be to connect the meter between cathode and grid, but this means connecting the negative lead of the meter, usually terminated with an uninsulated crocodile clip, to a point of "B+" potential. Since this can result in pain or bright sparks, it is often easier to measure both grid and cathode separately against ground and then to subtract one reading from the other. Make sure that the higher positive reading is that of the cathode.

Due to the fact that the "cathode resistor" of the stacked-B+ output tube includes the whole i.f. strip and usually a few more stages as well, the voltage registered at the cathode does not reliably indicate the amount of current flowing. The easiest way to measure cathode current is to insert a 10-ohm resistor in series with the cathode and to measure the drop across it. Any low value will serve but, as mentioned before, 10 ohms make it easy to calculate mentally.

Plate current alone can be easily checked by measuring the drop across the plate decoupling resistor, if one is present between "B+" and the primary of the output transformer.

Sync Troubles

The first test point in the sync section is the grid of the first tube in the sync chain, usually labeled "sync separator." Checking at this point (A in Fig. 5) with a v.t.v.m. should show negative voltage when signal is being received. The actual voltage varies over a wide range, depending on the setting of the contrast control, but we can say that we should expect at least -10 volts under signal conditions.

This is chosen as the key test point because the v.t.v.m. is of use here. If the scope is already in use, it is sensible to go straight to the plate of the tube and look for 15,750-cps "pips." If no pips or pulses are present, then the grid input can be examined. Normally a complete video-information envelope should be present at the grid, somewhat lower in amplitude than that at the video-amplifier plate but of roughly the same shape.

The clipping action of the sync separator is accomplished by the production of self-bias at the grid. As contrast is increased, the waveform applied to the sync separator grid should increase in amplitude and, to counteract this, the self-bias should also rise, keeping down conduction of the tube so that it still conducts only on the tips of the sync pulses. At no time should anything appear at the plate except pips.

If vertical lock is perfectly normal, the sync separator and phase inverter are probably working fine and the key test point is the input grid of the horizontal oscillator (or the control section in the case of Synchroguide circuit—see Fig. 6).

Again we can look for bias with the v.t.v.m. and this time the d.c. may be positive or negative. The important thing is—does the voltage vary smoothly as the horizontal-hold control

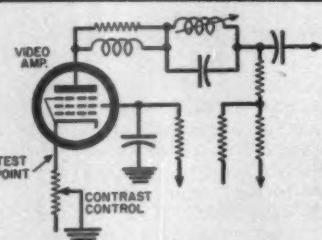


Fig. 2. Cathode voltage of the video amplifier reports on stage operation.

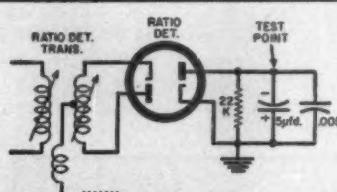


Fig. 3. The ratio-detector output load divides the audio circuits in half.

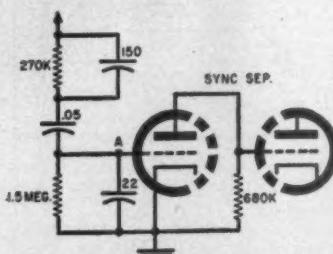
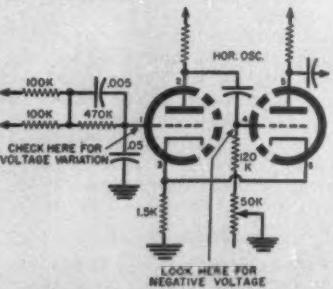


Fig. 4. Grid-cathode bias reflects operation of the audio-output stage.

Fig. 5. Negative voltage should be at point A of the composite sync system.

Fig. 6. Both grids of a horizontal multivibrator yield useful information.



is varied? Voltage should go more positive when the hold control is turned in one direction and more negative when it is turned in the other direction. This voltage variation is produced by the a.f.c. system to compensate for the change in frequency resulting from alteration of the hold control.

The Horizontal Oscillator

If the horizontal oscillator is suspected of being out of action, the key test point is the grid of the oscillator tube (pin 4 in Fig. 7), or if a Syncro-guide circuit is used, the grid of the blocking-oscillator section. As noted earlier, an oscillator develops negative voltage on the grid as grid current flows.

However, the technician must be careful in drawing conclusions from the presence of negative voltage here. Grid current does indicate that the oscillator is working, but it need not necessarily be on 15,750 cps. Also, as shown in Fig. 6, the bottom end of the grid-leak resistor (R) might be connected to a point of negative potential. In such cases, the voltages at each end of the grid-leak resistor should be compared.

Horizontal-Output Stage

Opinions differ among experienced technicians on which is the key test point in the horizontal-output stage—so let's settle for both and accord them equal merit. The control grid should show negative voltage due to grid current produced by drive from the horizontal oscillator. This varies a great deal from set to set, but 20 to 25 volts is the average. See Fig. 8.

Provided there is a cathode resistor, the positive voltage on the cathode will indicate how much current is passing through the tube. If there is no drive or if the plate-load impedance is upset by a fault beyond the tube, plate current will be excessive.

Vertical Deflection

The key point in the vertical oscillator is, again, the grid. Negative d.c. voltage is what we look for, of course. However, the grid is not as reliable a test point when it comes to the vertical-output tube. There is usually negative potential here but, with certain vertical-linearity and vertical-hold settings, there may be zero volts.

Often under signal conditions, a flickering of voltage will be observed on the output-tube grid. This would seem to indicate a leaking coupling capacitor, but a new, perfect replacement will leave the condition uncorrected. Don't let this phenomenon throw you.

A.G.C. Circuits

The point which offers the best indication of whether or not a keyed or gated a.g.c. section is doing its job is that shown as *A* in Fig. 9. The same d.c. exists at the plate of the a.g.c. tube but there is also a high-amplitude pulse here, derived from the horizontal

output stage, which may not improve the operation of the v.t.v.m.!

Most circuits have a voltage-divider network (in Fig. 9, the 330,000-ohm and 33,000-ohm resistors), which establishes the i.f. bias voltage at a certain proportion of the negative voltage developed at point *A*. Thus, at the key test point, there is something like 30 volts on a medium signal rising to maybe 50 on a strong one.

Although a measurement at this point will show whether or not the a.g.c. circuit is functioning, it cannot indicate whether the *correct amount* of a.g.c. voltage is being produced to compensate for the particular signal level being received. Fortunately, another test point is perfect for this purpose. This is the video-detector load resistor, referred to previously under the section "No Picture, No Sound."

The purpose of a.g.c. is to maintain a relatively constant level of output from the i.f. strip for a varying level of r.f. input to the tuner. Therefore, if the a.g.c. department is doing its job properly, the voltage across the video-detector load resistor should remain approximately constant when the channel selector is switched to signals of varying field strength. If only one channel is available, the same test can be made by alternately tightening and loosening the antenna coupling to produce the same effect as strong and weak signals, respectively.

If the test is made with the oscilloscope, noting the amplitude of the sync pulses will provide a good check on a.g.c. action. If you are using the v.t.v.m. to measure the d.c. bias across the detector load resistor, remember that this d.c. voltage is dependent on the *character* of the picture information as well as the sync-pulse amplitude. The meter reading is an indication of the *average black level* of the signal. Thus, for a given strength of carrier, more black in the picture produces a higher d.c. voltage across the load resistor.

A test pattern, for example, has a very low average black level. An examination of one such will show that only about one-twentieth of the total area of the picture is black or dark gray. The d.c. voltage produced across the load resistor by a test pattern is therefore much lower than that produced by the average transmitted program material on the same channel. This factor should be taken into account in making checks.

Sync-A.G.C. Interaction

The a.g.c. test point and procedure will solve many a perplexing sync gating problem in sets which utilize circuitry essentially similar to that shown in Fig. 10. The sync gating control, once set on the strongest station for stable sync, should hold good on weaker stations without having to be reset.

When it is found that different settings of the sync gating control are necessary to stabilize different signals, the technician usually starts to dig

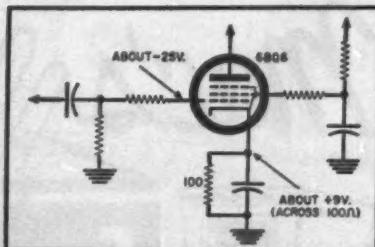


Fig. 8. In the horizontal-output stage, two check-points have earned equal merit.

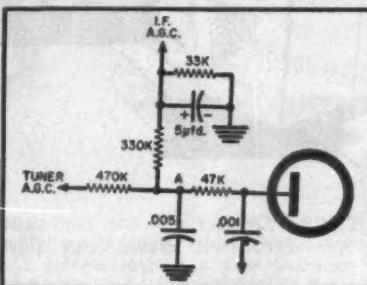


Fig. 9. In keyed-a.g.c. circuits, point *A* is convenient for checking, as it is isolated from the keying pulse.

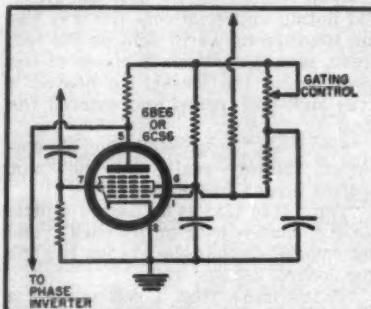


Fig. 10. Puzzling faults with sync-gating circuits are often a.g.c.-caused.

into the sync stage for a faulty component—but the trouble is usually in the a.g.c.! The basic test for a.g.c. effectiveness—measurement of the signal across the video-detector load resistor when changing from channel to channel—will prove it. Correct operation of the sync gating stage depends on the presence of a reasonably constant signal amplitude at the grid—and the reason for existence of the a.g.c. section is to accomplish exactly that. This same inter-relationship applies to certain types of noise-cancellation circuits.

Note on Cascode Tuners

In tuners where the cascode stage is fed from the 250-volt line through a decoupling resistor (usually about 1000 ohms), a guide to the operation of the stage can be gained by a measurement of the voltage drop across this resistor. However, don't rely too heavily on the figures given in the tube manual when figuring how much current flow to expect under normal conditions. In the struggle to reduce snow level, cascode

(Continued on page 96)

Mac's

Service Shop

By JOHN T. FRYE
CUSTOMER CUES

IT WAS October and the landscape was aflame with "Living Color." The morning was a perfect setting for the fall beauty. Barney stood for a moment before entering the shop looking at the morning-glory blue of the sky overhead, breathing deeply of the cool clean air rising from the dew-wet grass, and noting appreciatively the way the sun splashed its warm light on the red, green, purple, and russet leaves of the trees across the street. He heaved a little sigh and turned and entered the shop.

"Hey, boss," he greeted Mac, his employer. "Nature really has the color control turned full on today."

"Yep," Mac said as he flipped a little a.c.-d.c. chassis over on its back; "and did you notice that she always has the hue control set just right?"

"That's more than I can say for a lot of our customers," Barney remarked as he took his shop coat from the closet. "Most of them can't even tune a little radio like the one you're working on."

"Why do you say that?" Mac asked with a quizzical look.

"'Cause it's true. You know what a sloppy job of tuning ordinary black-and-white TV sets most people do."

"No I don't," Mac demurred. "People usually have a little trouble right at the beginning, but it's been my experience that most of them learn to do a pretty creditable job of adjusting the set, especially if the person who installs it does his job and gives them adequate instructions. They usually do not have the foggiest notion of what turning each knob actually does and quite often they cannot tell someone else how to adjust the receiver, but still and all most people manage to adjust their own sets so as to produce a good picture. They just keep twisting the knobs and watching the picture and listening to the sound until they stumble on a procedure that gets results. Eventually they act almost instinctively to correct any picture fault that shows up."

"One man's opinion!" Barney grunted.

"It's more than that," Mac insisted. "Recently a group at Iowa State College made a study for the FCC of just how well the average TV viewer adjusted his receiver and they were surprised to learn he does a darned good job of it. They found out he was just as capable of distinguishing between a good and bad picture as were the engineers—something few technicians will ever believe—and the great majority of viewers could set the controls to get the best possible picture."

"Maybe so," Barney admitted grudgingly; "but they certainly talk a lot of gibberish. They call a ghost a 'shadow,' confuse the contrast and brightness controls, and talk about the picture as being 'soft,' 'hard,' 'smooth,' 'grainy,' and goodness knows what all else."

"No law says they have to use our technical vocabulary. Keep that in mind. Instead of laughing at their terms, try hard to understand exactly what they mean. And along the same line, when you're making a house call, always try to maneuver the set owner into turning his receiver on and adjusting it if you can."

"Why?"

"For several reasons. For one thing, that relieves you of the necessity for hunting out the right controls. We know there's no reason in the world why a technician should have in mind the exact location of every control on hundreds of different models of TV receivers, but the customer can't grasp this. When he sees you fumbling around for the knob that turns the set on, he jumps to the conclusion you don't know much about his particular set."

"I'll buy that."

"Also, if he IS misadjusting his receiver, you have a chance to catch him at it. Of course you never tell him he has been doing something wrong, especially if his wife's in the room. You simply do it right and make sure that he sees how you do it. I am 'agin' the tendency of many technicians to regard their customers as being one cut above complete idiots. I know this makes for a lot of very funny smart aleck talk

among technicians—telling what stupid boo-boos their customers pull—but it is a dangerous pitfall for a technician. He wants the respect of his customers, but it's pretty hard to get respect unless you give it. And it's a cheap feeling of superiority you get from anointing yourself with the ego-salve of narrow technical knowledge. Insist on doing that and you are laying yourself wide open to being considered a moron by the doctor, lawyer, chemist, jeweler, automobile mechanic, and hundreds of other trades and professions."

"Don't worry about me," Barney said. "Now and then I get a little impatient because a customer has some wacky electronic idea or seems a little slow about grasping what I'm trying to tell him; but I don't pop off about what I think. Not to change the subject, how are you making out with that little receiver. I put in an hour on it last evening without finding out what was producing that funny squelch effect."

Before answering, Mac tuned the little receiver across the band. There was absolute silence between stations with no trace of normal hiss; but when strong stations were tuned in, the reception seemed normal.

"What all did you try?" Mac asked his assistant.

"Well, a gassy tube will often cause that; so I changed the mixer, i.f. tube, and the combination detector-a.v.c.-first-audio tube. No dice. Then I decided maybe the audio coupling capacitor was open until a strong signal temporarily bridged the break, but paralleling it with a good capacitor made no difference. Next I checked the a.v.c. resistors to see if any were open or had seriously changed value. All were OK. By then it was time to knock off."

"And if I know you, you dropped the solder gun at the first stroke of the clock," Mac growled. "Let's get out the signal tracer."

The signal was easily traced through the mixer, the i.f. amplifier, and right up to the secondary of the second i.f. transformer; but there it disappeared. That is, it disappeared until a strong signal was tuned in. When weak signal was being received, the signal was present across the transformer primary, but it could not be picked up across the secondary.

Mac laid aside the signal tracer probe and flipped on the v.t.v.m. Carefully he checked the voltages at the pins of the 12AT6. When the probe was touched to the diode detector plate, a small positive voltage was noticed. Mac tried another tube without changing the condition. Then he picked up the diagonal cutters and cut the lead going from the i.f. transformer secondary to the diode plate. The voltage appearing on the cut transformer lead became still more positive. Quickly and deftly Mac cut loose the leads of the small slug-tuned transformer and lifted it out of the chassis. He switched to the ohmmeter and measured the resistance appearing between the two windings.

(Continued on page 124)



Stereo Broadcasting

NOW AND IN THE FUTURE



By MILTON S. SNITZER
Technical Editor

THE stereo fever is all around us. Stereo records and stereo tapes are —like June—"busting out all over" along with a complete array of phono cartridges, tape heads, and assorted electronic gear to go along for the ride. But we must not overlook the fact that a good many of our broadcast stations are converting to stereo too; some of them have already done so. This means that not only will we be able to play our own stereo but we can pick up some of the increasing number of stereo broadcasts, both live and recorded, that are being transmitted daily. As interest in stereo mushrooms, there is no doubt that stereo broadcasts will increase.

AM-FM and FM-FM Stereo

Up until now the most common methods of broadcasting stereo programs were by means of an AM and an FM station or by means of two FM stations. With the AM-FM method, one channel is picked up on an AM tuner or receiver while the second channel is picked up on its FM counterpart. There are several AM-FM tuners available having two separate outputs, one AM and the other FM, for receiving this type of program. Usually the two stations are affiliated with the same broadcasting company or some co-operative arrangement is made between two separately owned stations. This method has produced some good results. However, critics of the method argue that the system is wasteful of spectrum space since two complete stations are required. Also, reception of the AM channel may leave something to be desired. The signal-to-noise ratio and frequency response on AM is usually poorer than on FM and the coverage of the two signals may not be the same. As a result, the two channels will not be identical and the stereo effect will suffer.

With the FM-FM method, two separately owned stations usually co-operate so that one of the FM stations is broadcasting one of the stereo chan-

nels while the other FM station is transmitting the other channel. With this arrangement, two separate FM tuners would be required to receive the stereo program. The FM transmitters should be reasonably close to each other and of about the same power so that both channels are received equally well. Of course, two complete FM channels are required.

AM Single-Sideband

Several AM stations have recently experimented with a type of compatible single-sideband transmission that can be picked up on an ordinary broadcast set. (See "SSB Broadcasts Promise Hi-Fi" in our August, 1957 issue.) In this system only one of the two sidebands normally found in AM transmission is used. Although the system was not designed with stereo in mind, it would be possible to use one of the sidebands for one of the stereo channels, while the other sideband could be used for the other stereo channel. With this method, which is strictly AM, special circuits would be needed at the receiver to separate the two sidebands.

FM-Multiplex

When stereo broadcasts of the future are discussed, the FM-Multiplex method is invariably brought up. As a matter of fact, many FM tuners al-

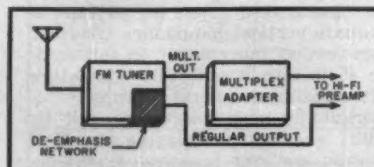
ready have a built-in "Multiplex output" jack for this possible use. With this method one of the stereo channels is transmitted by the FM station over its main channel. The other stereo channel is stepped up in frequency at the transmitter and the resulting supersonic signal is used to modulate the same FM carrier. This supersonic signal is said to be a sub-channel that has been multiplexed onto the carrier. If the transmitting equipment permits it, it would even be possible to have a second sub-channel multiplexed onto the same carrier.

At the receiver, the regular output from the main channel is obtained from the de-emphasis network. This reduces the high-frequency response to such an extent that none of the higher frequency sub-channels appears in this "regular output" channel. See Fig. 1. That part of the signal that is tapped off before de-emphasis (hence with all the higher sub-channel frequencies still present) is then applied to a special multiplex adapter. This unit, which could readily be made to sell for about 40 to 60 dollars, steps down the frequency of the multiplexed sub-channel to the audible range. After proper frequency selection, detection, and amplification, the output of the second channel is available.

At present the FCC has issued experimental-only licenses for this type of operation. But far more use is being made of FM-Multiplex for background music and storecasting than for stereo. As a matter of fact, there are over 51 FM stations now offering this latter service, compared to only 8 that have tried out the stereo broadcasts.

Although there are no official technical standards, most stations operate as follows. The first sub-channel uses a center frequency of 67 kc. with a deviation of ± 8 kc., thus using the space

(Continued on page 132)





Stereo Disc

In 1931 a British patent (#394,325) by A. D. Blumlein described a stereo disc having but a single groove similar to the 45-45 disc now being produced in this country. Mr. Blumlein, in his patent application, also discussed at length many of the problems associated with stereophonic recordings.

He discussed other possible stereo disc recording methods, such as the vertical-lateral system, but dismissed them as impractical. In 1936, Rafuse and Keller of Bell Telephone Laboratories patented a vertical-lateral cutter described in U. S. Patent #2,114,471. This cutter could also cut 45-45 stereo discs.

In 1952 Mr. Emory Cook produced stereo discs with two separate grooves which required two independent pickups for playback and, of course, two independent cutters for recording.

Recently there has been a flurry of technical activity in both the USA and abroad to produce a stereo disc capable of high-fidelity sound. At the New York High Fidelity Show in October of 1957, two systems were demonstrated: the 45-45 and the vertical-lateral. Both of these systems were well received and a number of industry committees held meetings to decide which system to adopt. After a series of meetings a decision was reached by the RIAA (Record Industry Association of America) to adopt the 45-45 system as standard.

A recent arrival on the scene, the MSD, or "Minter Stereo Disc," was announced to the industry committees in November and December, 1957 and demonstrated to them in January, 1958. A still later stereo disc variation was announced by Dr. Peter Goldmark of Columbia in March, 1958. Dr. Goldmark's system is really a modifi-

cation of the existing 45-45 system and will be discussed later.

To classify these various systems, Table 1 has been prepared. In the second column of this chart the different groove motions are sketched, while the other columns list some of the important characteristics.

45-45 System

The two stereo channels, right and left, are recorded on a 45-45 disc at 45 degrees to the surface of the record. Since these two movements occur at 90 degrees to one another, the cross-talk between channels is theoretically zero. If this 45-45 record is played with a stereo pickup designed with two responsive elements suitably oriented, the cross-talk ratio or separation is better than 20 db (ten to one) over most of the frequency range. If this special pickup has its dual outputs parallel-connected electrically, a monaural (lateral) record can be played with good results—in this sense the pickup is compatible with existing lateral recordings. If the leads are not connected in parallel electrically but are left connected to each individual amplifier and speaker system, some distortion will result due to the "pinch effect" inherent in lateral monaural recordings. This pinch effect results in vertical movement of the stylus which is normally not reproduced by a lateral pickup.

If the 45-45 disc is played with a standard lateral pickup, the record may be damaged unless the pickup has adequate vertical compliance (freedom from vertical movement). In this sense the 45-45 disc is not fully compatible with existing monaural pickups.

Originally a standard one mil tip radius was used for playing the 45-45 records; however practical experience

has led to use of 0.7 mil tip radius. A recent survey of the industry shows a further decrease in tip radius as being desirable—perhaps to 0.5 mil. Fortunately tip radius size can be changed within these limits, since most master records are made with a 0.2 mil tip radius on the cutting stylus. Use of a smaller tip radius implies the reduction of stylus force, if record wear is to be avoided.

The playing time without automatic margin (spacing) control is less than a conventional LP because of the increased space occupied by the 45-45 groove. Fortunately the proper combination of automatic margin and automatic depth control makes it possible to increase the playing time up to about the same as a standard LP. The maximum playing time will remain shorter than a monaural LP designed for the same playback tip radius and utilizing the same efficiency of automatic margin and depth control.

Since a 45-45 pickup responds to both vertical and lateral vibration, vertical rumble in the turntable will produce undesirable disturbances unless means are taken to reduce it. Two approaches have been made by the industry in this direction: first, improvement of the turntable design to reduce rumble at its source and second, the reduction of sensitivity in the pickup cartridge to low-frequency (where rumble occurs) vertical motion. Fortunately, these two approaches have helped reduce vertical rumble to an acceptable level.

Vertical-Lateral

In the vertical-lateral system the two stereo channels are recorded simultaneously in a single groove by modulating the groove laterally in re-



The author received his B.S. degree in electrical engineering in 1934 from M.I.T. In 1935 he was employed by Boonton Radio Corp. in the development of I.F. transformers and, in 1936, he was active in developing aircraft radio receivers at Radio Frequency Laboratories in Boonton, New Jersey. Mr. Minter organized Measurements Corp. in 1939, which company specialized in field-intensity measuring equipment and standard signal generators. He was vice-president of Measurements Corp. until 1953, when he resigned to devote his full time to Components Corp., of which he has been president since 1956. Mr. Minter is active in a good many professional societies and has served as president of both the Radio Club of America and the Audio Engineering Society. He has served on numerous Standards Committees and holds several patents in the audio field. Recently he has been active in the disc-recording field, having developed the "Hydroset" lathe and MSD stereo disc recording system.

A comprehensive summary and comparison of the various systems used to record stereo on discs.

Recording Methods

By JERRY B. MINTER President, Components Corp.

sponse to, say, the right channel and the groove vertically in response to the left channel. This system was proposed as a standard by *London Records* in close cooperation with *Telefunken* and British *Decca*. It is called "Teledec," a coined word derived from these two latter company names. Quite possibly this system may be used to some extent in Europe.

Since the motion of the groove occurs in two directions at the same time, the technique has many features in common with the 45-45 system. For example, a 45-45 pickup can be modified by electrical circuitry to play a vertical-lateral record stereophonically. Likewise a vertical-lateral pickup can be also modified electrically to play a 45-45 disc.

Unfortunately the vertical-lateral system is not compatible with a monaural record, since only one channel would be reproduced when it is played with a lateral pickup.

The playing time of a vertical-lateral disc will be shorter than a monaural LP for much the same reason as given in connection with the 45-45 disc. Undoubtedly some of this playing time can be recovered by proper application of automatic margin and depth control as in the 45-45 system.

As for vertical rumble—this vertical-lateral system has it in just one channel—but this is probably worse, since reduction of low-frequency response of either channel cannot be employed as a means of reducing rumble in a truly hi-fi system. Therefore all of the improvement will have to originate in the turntable.

Undoubtedly the combination of the various shortcomings just listed resulted in elimination of the vertical-lateral system as a contender for acceptance in this country. Neverthe-

less demonstrations of the vertical-lateral system were very favorably received last October and further European developments will be watched with interest.

Cook

Two separate grooves, one for the right and one for the left, are spaced about 1½ inches apart on the Cook stereo record. Two separate pickups are used on a special double arm for playing these records. Of course, two standard LP pickups could be used and these are generally available at lower cost than the special 45-45 stereo cartridges.

Unfortunately less than half of the playing time can be had on a Cook record as compared to a standard monaural LP. This is a serious limitation—perhaps a smaller stylus and finer grooves would help here—but still on an equal basis the Cook stereo disc is one-half as efficient in utilization

of the record surface that is employed.

Vertical rumble is no special problem with the Cook disc—but there are some new problems not common to any other system: The spacing between groove pairs is not maintained accurately in production of the pressings. This variation results in groove jumping of one of the pickups so that the two channels are no longer "in sync"—a truly disturbing experience. Then, too, it is difficult to start them off "in sync." The physical problem of trying to start two different pickups exactly the correct number of lines apart was never solved in most of the commercial arms offered for sale. Cook stereo discs are no longer being made in this country.

MSD

The "Minter Stereo Disc" was described in the April, 1958 issue of this magazine ("All-Lateral Stereo Disc (Continued on page 112)

Table 1. Characteristics of the stereo disc recording systems discussed in text.

NAME	SECTION OF GROOVE	COMPATIBILITY (with monaural)	PICKUP	PLAYING TIME (compared to LP's)	VERTICAL RUMBLE SUSCEPTIBILITY
45-45		Yes*	Special	Shorter	Yes*
Vertical-Lateral		No	Special	Shorter	Yes
Cook		Yes	Standard	Less than half	No
MSD		Yes	Standard*	Same*	No

*With qualifications, see text.

TOPICAL LISTING OF TERMS COVERED IN GLOSSARY

FORMS OF AUDIO REPRODUCTION

1. Monaural
 2. Monophonic
 3. Binaural
 4. Stereophonic
 5. Pseudo-Stereo
 6. Coded Stereo
- SOUND CHANNELS
7. Channel
 8. Phantom Channel
- STEREO OVER THE AIR
9. Stereocasting
 10. Simulcasting
 11. Multicasting
 12. Multiplexing
- STEREO ON PHONO DISCS
13. Dual-Groove Record
 14. Single-Groove Record
 15. Carrier-Frequency Stereo Disc
 16. CBS Stereo Disc
 17. Minter Stereo Disc
 18. Vertical-Lateral Stereo Disc
(Sugden: London)
 19. Westrex Stereo Disc
(45 45: Vector)
- STEREO ON TAPE
20. In-Line Head
 21. Stacked Head
 22. Staggered Heads
- FEATURES OF STEREO AMPLIFIERS
23. Balance Control
 24. Focus Control
 25. Master-Gain Control
 26. Tracking
 27. Phase Reversal Switch
 28. Speaker Reversal Switch
- STEREO MICROPHONE TECHNIQUES
29. Left-Right Recording (Classical)
 30. Listening Angle Principle
 31. Longitudinal Recording
 32. Mid-Side Recording (M-S)
 33. Stereoionic Recording
- DIFFERENCE FREQUENCY PRINCIPLE
34. Difference Frequency
 35. Sum Frequency
- STEREO PROBLEMS
36. Hole in the Center Effect
 37. Dummy Speaker
 38. Matching
 39. Cross Talk

THE advent of stereo has added new terms to the audio vocabulary and given special meaning or emphasis to old terms. The following glossary seeks to explain most of the stereo terms that, at the time of writing, appear of significance to the audiophile. Common usage rather than semantics underlies these definitions. Unless otherwise stated, it should be understood that reference is to two-channel stereo, the only kind generally available to the public at the present time. Terms are not defined generally but only insofar as they apply to stereo usage.

Since an alphabetical arrangement of stereo terms would make for helter-skelter reading, they have been arranged according to topic instead. In

Stereo Glossary

By HERMAN BURSTEIN

To understand stereo you must know the language. Here are the most important terms and their meanings.

order that the reader may quickly locate a term in which he is interested, a "Topical Listing" is included, left. Any term in the listing can be located in the glossary by number.

Forms of Audio Reproduction

1. Monaural: Audio information on one sound channel. Usually, although not necessarily, associated with one speaker system.

2. Monophonic: Same as monaural. Term coined as the counterpart of stereophonic.

3. Binaural: Audio information on two sound channels, intended for reproduction by earphones, one for each channel. Usually recorded by two microphones about six inches apart, with an intervening partition, thereby simulating the manner in which the human ears intercept sound.

4. Stereophonic: Audio information on two (or more) sound channels, intended for reproduction by an equivalent number of speaker systems. Recorded by various techniques. Stereophonic recording is still in a highly experimental stage and therefore it is not yet possible to identify stereophonic reproduction with particular types or placement of microphones.

5. Pseudo-Stereo: Devices and techniques for obtaining from a single channel source some of the qualities associated with stereo. Simplest method is to feed the single-channel source to two speaker systems spaced several feet (or more) apart. One method, commercially known as "Xophonic" (made by *Radio Craftsmen*), acoustically delays all the frequencies by about 1/20th second by passing them through a long tube then feeding them to a second speaker. Other devices operate electronically, achieving a time delay which varies with frequency; this tends to have the effect of spatially distributing the various orchestral instruments. Also see Coded Stereo, Item 6.

6. Coded Stereo: Known in one form as "Perspecta Sound," employed in theaters. Consists of single channel audio accompanied by a sub-sonic code signal that controls the volume of sound fed to speakers at the left, center, and right. Thus if drums are to appear on the left, the coded sub-sonic

signal causes the system to supply relatively more power to the speaker on the left when the drums are playing. (See "A New Approach to Hi-Fi Stereophony" in the August, 1956 issue and "Coded Stereo for Hi-Fi" in the June, 1957 issue.)

Sound Channels

7. Channel: A signal pathway for conveying audio information during recording, transmission, or reproduction; also refers to the audio information so conveyed. Where more than one channel is employed, they differ from each other in at least one, but not necessarily all, of the following respects: frequency content, relative amplitude of various frequencies, phase, arrival time, reverberation. Typical stereo employs two channels, one intended for a speaker at the left front of the listener and the other for a speaker at the right front. By operating both channels at once, the total sound is conveyed to the listener, including a sense of direction. The left channel and speaker are identified by the number 1 or letter A. The right channel and speaker are identified as 2 or B. In recording, a third sound channel is often employed, designed to pick up the sound in the center. However, for conventional stereo, which employs only two channels in the final program source (radio, disc, or tape), the signal of the center channel is mixed with the program material of both the left and right channels.

8. Phantom Channel: Some stereo reproducing systems employ a speaker in the center as well as at the left and right, although the program source contains only two channels. The signals in the left and right channels are electrically combined to form a phantom channel, which is fed to the center speaker.

Stereo Over the Air

9. Stereocasting: Broadcasting two sound channels for stereo reproduction. There are now three techniques, listed according to present extent of usage: simulcasting, multicasting, and multiplexing. These are described in Items 10, 11, and 12.

10. Simulcasting: Broadcasting a stereo program by means of an AM

and FM station (usually jointly owned). Requires an AM and an FM tuner.

11. **Multicasting:** Broadcasting a stereo program by means of two FM stations. Requires two FM tuners.

12. **Multiplexing:** Broadcasting a stereo program by means of a single FM station. One sound channel is broadcast in the conventional manner. The other channel frequency modulates a subcarrier of either 67 kc. or 42 kc. The conventional FM tuner detects the first channel and the subcarrier. A multiplex adapter, which in the future may possibly be incorporated on the same chassis as a conventional FM tuner, extracts the second channel from the subcarrier.

Stereo on Phono Discs

13. **Dual-Groove Record:** Employs an outer set of grooves for one channel and an inner set for the other channel. Requires two cartridges side-by-side for playback. Cartridge alignment must be precise so that the stylus of each will enter the proper groove. This method is no longer in commercial use.

14. **Single-Groove Record:** Employs a single set of grooves for stereo material and requires only one cartridge with one stylus for stereo playback. There are two basic methods: those employing both vertical and lateral modulation of the groove; and those employing only lateral modulation (in the manner of a monaural record) together with a modulated carrier frequency. The vertical-lateral techniques are embodied in the Vertical-Lateral Stereo Disc, the CBS Stereo Disc, and the Westrex Stereo Disc (although in this latter method the cutting angles are shifted 45 degrees). The lateral techniques include the Carrier Frequency Stereo Disc and Minter Stereo Disc.

15. **Carrier-Frequency Stereo Disc:** One channel is cut laterally in the usual manner. The second channel is employed to frequency modulate a supersonic carrier frequency, which is also cut laterally. The playback cartridge delivers the signal for one channel plus the carrier frequency containing the other channel. The carrier must then be demodulated to furnish the second channel.

16. **CBS Stereo Disc:** Developed by the Columbia Broadcasting System, this disc is cut vertically and laterally. But it may be played back on a 45-45 cartridge, which has two elements, one responding to stylus motion at an angle of 45 degrees to one side of vertical and the other element responding to stylus motion at a 45-degree angle to the other side of vertical (See discussion of Westrex Stereo Disc). The sum frequency of the two sound channels, $A + B$, is cut laterally. The difference frequency, $A - B$, is cut vertically. This is done at a much reduced level. In playback, the 45-45 cartridge acts as a matrixing device, so that one of its elements delivers essentially an A signal while the other

delivers essentially a B signal. (See "New Compatible Stereo Disc" in the June, 1958 issue.)

17. **Minter Stereo Disc:** The sum of the two channels, namely $A + B$, is cut laterally. The difference between the two channels, $A - B$, is obtained electrically and employed to frequency modulate a 25 kc. carrier, which is also cut laterally. In playback, a monaural type pickup (responding only to lateral stylus motion) with relatively flat response to 30 kc. is used. While the cartridge immediately delivers the $A + B$ information, special electronic equipment is used to obtain the $A - B$ information and to mix it with the $A + B$ signal so as to derive separate A and B signals. The technique for doing this is illustrated in Fig. 1. The $A - B$ signal is extracted by an FM detector and combined with the $A + B$ signal to produce A information; then the $A - B$ signal is phase inverted to form $B - A$, which is combined with the $A + B$ signal to produce B information.

18. **Vertical-Lateral Stereo Disc:** Identified with the names of Sugden and of London Record Co. The groove is cut vertically for one channel and laterally for the other. The playback cartridge contains two elements, one responding to vertical stylus motion and the other to lateral stylus motion.

19. **Westrex Stereo Disc:** Also known as the 45-45 Disc or Vector Disc. The record groove is in the form of a "V" and each wall of the "V" is at 45 degrees to vertical. The left wall is recorded so that it contains channel A information (for the left speaker) and the other wall contains channel B information. The signal for the left speaker causes the stylus to move at a 45-degree angle to vertical, namely from bottom left to top right; that is, the left side is cut in a manner that causes the stylus to move slantwise along the right wall. The right channel causes the stylus to move from bottom right to top left, along the left wall. A combination of signals from both channels causes the stylus to move in some intermediate position. The cartridge employed for playback—the so-called 45-45 cartridge—contains two elements, one responding to stylus motion at an angle of 45 degrees to right of vertical and the other responding to stylus motion at an angle of 45 degrees to left of vertical.

Stereo on Tape

20. **In-Line Head:** Consists of two tape heads in a single casing, one mounted directly above the other so that their gaps are in exact vertical alignment. If the stereo tape runs from left to

right, the upper head reproduces (or records) the left channel and the lower head the right channel. The in-line playback head is suitable only for a recorded stereo tape with one channel directly above the other. It is not suitable for a staggered tape (see Item 22).

21. **Stacked Head:** Same as In-Line Head.

22. **Staggered Heads:** Separate heads, spaced about $1\frac{1}{4}$ " apart, for playing (or recording) the upper and lower halves (tracks) of a stereo tape. If the tape runs from left to right, the head on the right is for the right channel and operates on the lower track of the tape. Staggered heads are suitable only for the recorded tapes with tracks staggered in corresponding fashion. Staggered heads and staggered tapes are virtually obsolete.

Features of Stereo Amplifiers

23. **Balance Control:** Device on a stereo amplifier to vary the volume of each speaker system relative to the other, at the same time maintaining their combined volume virtually the same. As one speaker increases and the other decreases in volume, sound appears to shift from left to center to right or vice versa.

24. **Focus Control:** Same as Balance Control.

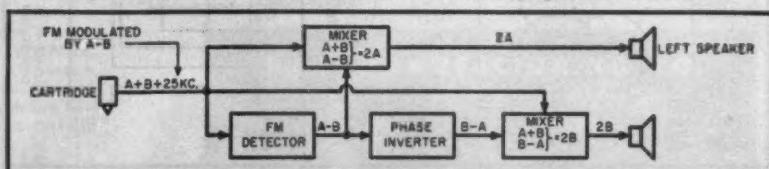
25. **Master Gain Control:** Device on a stereo amplifier to simultaneously control gain of both channels.

26. **Tracking:** A function of the master gain control in a stereo amplifier, namely to maintain the same difference in volume between the two channels at all settings of the control. This difference, which may be zero (representing equal volume from each speaker), depends upon the setting of the balance control. Good tracking exists if the master gain control at any setting does not cause the difference between channels to change by more than 1 or 2 db.

27. **Phase Reversal Switch:** Device on a stereo amplifier, or in a speaker system, for shifting phase by 180° on one channel. This can mean merely interchanging the two leads to one of the speaker systems. If stereo speakers are improperly phased relative to each other, sound may appear to come from the center instead of having wide spatial distribution. Improper phasing can also lead to partial cancellation at some frequencies due to one speaker diaphragm moving in while the other is moving out.

28. **Speaker Reversal Switch:** Device on a stereo amplifier for connecting the left channel to the right speaker and vice versa. May be a means of

Fig. 1. Simplified block diagram of electronics used in playback of Minter disc.



correcting for improper left-right orientation in the program source.

Stereo Microphone Techniques

29. Left-Right Recording: Also known as classical stereo recording. Microphones are placed at left and at right on a line parallel to the sound source. Usually the microphones are placed 6 to 20 feet apart; sometimes more in order to enhance the effect of spatial distribution. For binaural reproduction (through earphones), the microphones are usually placed about six inches apart, with an intervening object to simulate the human head. Sometimes, although infrequently, the latter technique is employed for stereophonic purposes. At frequencies where the stereophonic effect is most pronounced, namely above 1000 cycles, there are substantial phase differences in the sounds reaching each of the two closely spaced microphones. Hence, even though the speakers used in reproduction are several feet apart, there can be some kind of stereophonic effect resulting from pickup by microphones only six inches apart. When microphones are spaced a substantial number of feet apart, often a center microphone is also employed. At some stage in the recording process, the sound of the center channel is added to left and right channels.

30. Listening Angle Principle: A principle sometimes employed in Left-Right Recording. The microphones at the left and right, as shown in Fig. 2, are spaced so that they are on the angle formed between a listener in a favorable seat at the original performance and approximately the extreme ends of the music source. It is intended that the same angle should be formed between the listener and his two speaker systems, more or less. Hence the microphones and the speakers, through a common angle, in effect attempt to put the listener in the

"favorable seat" he might have occupied at the original performance.

31. Longitudinal Recording: Microphones are spaced along a line at right angles to the music source (i.e., from front to back). The result is a time delay between channels, as well as differences in amount of reverberation; typically, the microphone closer to the source picks up more direct and less reverberated sound.

32. Mid-Side Recording: Referred to as M-S Stereophony. See Fig. 4. Employs one cardioid microphone and one cosine (figure-8 polar pattern) microphone very close together. The cardioid is oriented to pick up all the audio information, which may be called $A + B + C$, with A representing the left, B the right, and C the center. The cosine microphone is placed so that its figure-8 reception pattern is parallel to the sound source, thereby picking up more of the sound on the left (A) and on the right (B) than in the center. The A sound picked up by the cosine microphone is 180° out-of-phase with the B sound inasmuch as the microphone has but one pressure-sensitive element, which obviously cannot move two ways at once. Hence the sound picked up by the cosine microphone may be called $A - B$. Fig. 4 shows how the signals of the two microphones are combined. The $A - B$ signal plus the $A + B + C$ signal produces a $2A + C$ signal. The $A - B$ signal is then combined out-of-phase (thus becoming $B - A$) with the $A + B + C$ signal, producing a $2B + C$ signal. In sum, one channel contains information principally from the left, and the other contains information principally from the right; each also contains some center information.

33. Stereosonic Recording: Similar to Mid-Side Recording, it employs two microphones very close together and relies largely upon intensity differences in the signal picked up by each

one. As shown in Fig. 3, each microphone has a figure-8 pattern, oriented 45° to the sound source. One microphone picks up sound essentially from the left, while the other picks up sound essentially from the right. If desired, a combined output signal can be obtained from the two microphones in a manner similar to that shown in Fig. 4 for Mid-Side Recording.

Difference Frequency Principle

34. Difference Frequency: Signal representing, in essence, the difference between the left and right sound channels, namely $A - B$. Usually obtained by simple electronic means (one signal is phase inverted 180° and then added to the other signal); also achieved by microphone techniques (see Mid-Side Recording, Item 32). Use of a difference frequency in recording, radio transmission, etc., is an application of information theory, enabling audio information to occupy a smaller portion of the chosen medium; that is, the difference between two like signals is less than either signal alone. In the case of stereo discs, use of the difference frequency for vertical modulation of the groove results in a smaller vertical cut than if either of the original channels governs the amount of vertical modulation. This reduces the problem of vertical compliance in the playback cartridge and hence makes for greater compatibility between monaural pickups and the vertical-lateral type of stereo disc. In the case of multiplex transmission, if a difference frequency were used to modulate the subcarrier, this would reduce the problem of cross-modulation between the main carrier (and its sidebands) and the subcarrier (and its sidebands). Moreover, use of the difference frequency technique requires a complementary sum frequency, namely $A + B$, which contains the total audio information. Broadcasting the $A + B$ signal on the main radio channel of an FM-FM, FM-AM, or FM-multiplex stereo program would provide the monaural listener with the full audio information in the original program.

35. Sum Frequency: Sum of the left and right sound channels. See discussion of Difference Frequency, Item 34.

Stereo Problems

36. Hole-in-the-Center Effect: Apparent absence or insufficiency of sound in the region between the left and right speakers. This effect may occur if the recording microphones and/or stereo speakers are placed too far apart. In the case of an orchestral composition, it might seem as though the left and right halves of the orchestra had been sundered and moved a considerable distance apart.

37. Dummy Speaker: A psychological device to overcome the Hole-in-the-Center Effect, consisting of a speaker system, or merely a speaker enclosure, placed between the left and right
(Continued on page 134)

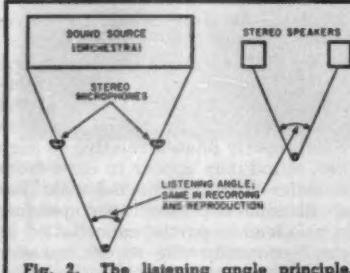


Fig. 2. The listening angle principle.

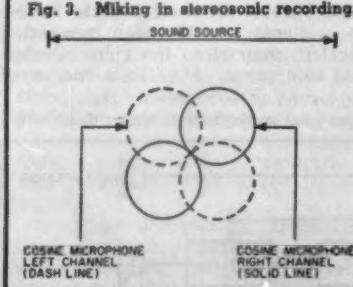
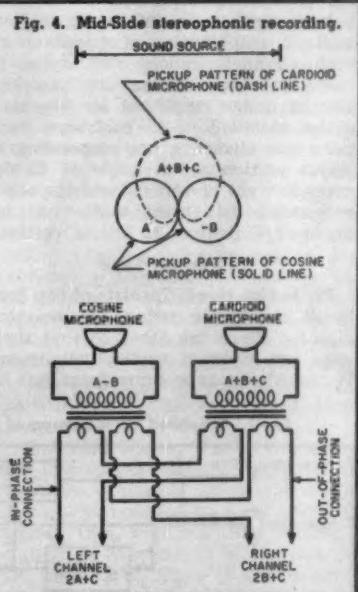


Fig. 3. Mixing in stereosonic recording.



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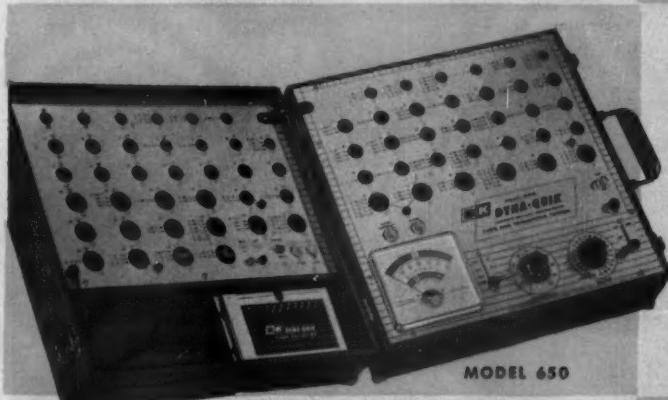


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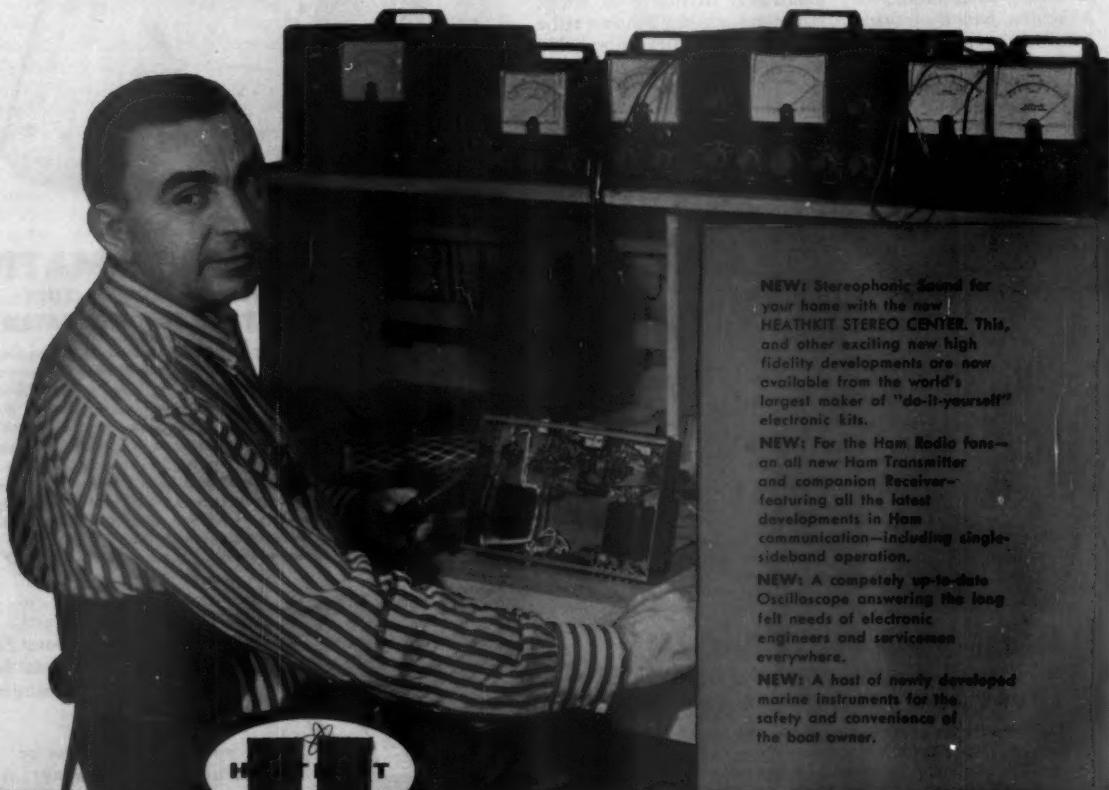
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...Rigid quality standards of components used in HEATHKITS assure me of performance equal to or surpassing instruments costing many times more.

...after assembling a HEATHKIT myself, I know what "makes it tick"... I know that the thoughtful circuitry design and name-brand components used throughout guarantee me years of trouble-free service.

...HEATHKITS cost me half as much as ordinary equipment... and I get so much more. In assembling my own instruments I am sure of the quality that goes into them. Plus the complete assembly and operating instructions as well as detailed schematics that are at my fingertips for future reference."



NEW: Stereophonic Sound for your home with the new HEATHKIT STEREO CENTER. This, and other exciting new high fidelity developments are now available from the world's largest maker of "do-it-yourself" electronic kits.

NEW: For the Ham Radio fan—an all new Ham Transmitter and companion Receiver—featuring all the latest developments in Ham communication—including single-sideband operation.

NEW: A completely up-to-date Oscilloscope answering the long felt needs of electronic engineers and servicemen everywhere.

NEW: A host of newly developed marine instruments for the safety and convenience of the boat owner.

The HEATH TIME PAYMENT PLAN allows you to outfit your whole workshop at one time with needed test instruments while you pay in easy monthly installments.

HEATH COMPANY Benton Harbor 15, Michigan

Subsidiary of Daystrom, Inc.



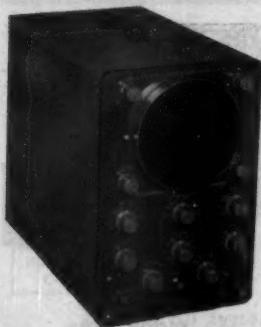
PROFESSIONAL OSCILLOSCOPE KIT

An exciting development in the Heathkit test instrument line is the introduction of the Heathkit model OP-1 Professional Oscilloscope. Emphasizing complete flexibility in any application, the OP-1 features DC coupled amplifiers and also DC coupled CRT tube un-blanking. The triggered sweep circuit will operate on either internal or external signals and may be either AC or DC coupled. The polarity of the triggering signal may also be selected, and any point on the wave form may be selected for the start of the sweep by using the "triggering level" control. An automatic position is also provided, in which the sweep recurs at a 50 cycle rate, but can be driven over a wide range of frequencies with no additional adjustments. The sweep frequencies are provided by switch-selected base rates of 2 and .2 milliseconds/CM, and 20, 2, and 1 microseconds/CM, in conjunction with a continuously variable 10 to 1 multiplier. Sweep frequencies are calibrated to within 10% at all control settings, and the sweep frequency may be reduced by adding capacity to the "ext. cap" binding post on the front panel. A 5ADP2 flat face CR tube is used for accurate readings on an edge lighted grid screen. A high quality conetic-fernetic CR tube shield prevents stray AC fields from distorting trace. A 12-position vertical attenuator is calibrated in volts-per-CM and the horizontal sweep is calibrated in time-per-CM. Pre-wired terminal boards are used for rapid, easy assembly of all critical circuits. Simply install and connect the color coded leads. Power supply is transformer operated utilizing silicon diode rectifiers and is fused for protection. Under development for over a year the OP-1 promises outstanding results in any application requiring the use of an oscilloscope.



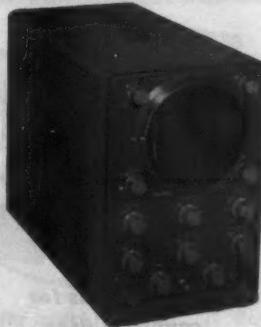
HEATHKIT
OP-1
\$179.95

**Here's the scope you've
been waiting for!**



**Laboratory
Performance At Less
Than Utility Scope
Price**

HEATHKIT
O-12 **\$65.95**



**A Scope You Will Be
Proud To Own**

HEATHKIT
OM-3 **\$39.95**

"EXTRA DUTY" 5" OSCILLOSCOPE KIT

Top quality features at half the cost of ordinary equipment sum up the advantages of this popular kit. Critical observations in your laboratory or shop are handled easily, with clear, sharp pattern displays in every application. Vertical frequency response extends from 3 CPS to 5 mc \pm 1.5 db —5 db without extra switching. Response is down only 2.2 db at 3.58 mc. The Heath patented sweep circuit functions effectively from 10 CPS to better than 500 kc in five steps, giving you 3 times the usual sweep obtained in other scopes. An automatic sync circuit with self-limiting cathode follower provides excellent linearity and lock-in characteristics. Extremely short retrace time and efficient blanking action. Both vertical and horizontal output amplifiers are push-pull and the scope incorporates a 1-V peak-to-peak calibrating source, step attenuated and frequency compensated vertical input, plastic molded capacitors and top quality parts throughout. The 11-tube circuit features a SUP1 cathode ray tube, and provision is made for Z-axis input for intensity modulation of the beam. Frequency response of the horizontal amplifier is within \pm 1 db from 1 CPS to 200 kc. Horizontal sensitivity is 0.3 volts RMS per inch. Construction is simplified through the use of two metal circuit boards and pre-cut, cable wiring harness. Shpg. Wt. 22 lbs.

GENERAL PURPOSE 5" OSCILLOSCOPE KIT

For servicing and routine laboratory work this fine kit is a favorite with technicians throughout the country. It incorporates many extras not expected at this low price. Features wide vertical amplifier frequency response, extended sweep generator operation, and improved stability. Frequency response of the vertical amplifier is within \pm 3 db from 4 CPS to 1.2 mc. Vertical sensitivity is .09 volt RMS per inch at 1 kc. Sweep generator functions reliably from 20 CPS to over 150 kc. A modern etched circuit board is featured for high stability and reduces assembly time considerably. Standard components are mounted on this board with each position clearly marked preventing wiring errors. Both vertical and horizontal amplifiers are push-pull types. Uses a 5BP1 CRT. Provision for external or internal sweep or sync, built in 1-V peak-to-peak reference voltage and calibrated grid screen. An adjustable "spot shape" control is provided to insure a sharp trace. Input to the vertical amplifiers is through a step attenuated, frequency compensated circuit. The OM-3 is an extremely versatile instrument and has a multitude of practical uses in electronic testing fields. Particularly useful in alignment of television receivers, for testing audio amplifiers and circuits, and checking the quality of modulated RF signals in Ham Radio transmitters. Shpg. Wt. 22 lbs.



Equip Your Service Bench...



HEATHKIT
CD-1

\$59.95

Cash In Now On Color TV

- ★ 10 VERTICAL COLOR BARS
- ★ CRYSTAL CONTROLLED ACCURACY
- ★ CHOICE OF 6 DIFFERENT PATTERNS



HEATHKIT
TS-4A \$49.50

For fast,
easy alignment
of TV sets



HEATHKIT
AG-10 \$49.95

Sine and
square waves for
countless uses



HEATHKIT
MM-1 \$29.95

High accuracy
in a
portable meter



HEATHKIT
M-1 \$17.95

An all-round
meter of
many uses

TV ALIGNMENT GENERATOR KIT

This generator has many special design features for flexible, easy operation and reliability. The all-electronic sweep circuit insures stability and covers 3.6 mc to 220 mc in four bands. Sweep deviation is controllable from 0 to 42 mc. Crystal and variable marker oscillators are built in. Crystal (included with kit) provides output at 4.5 mc and multiples thereof. Variable marker provides output from 19 to 60 mc on fundamentals and from 57 to 180 mc on harmonics. Effective two-way blanking and phasing control also provided. A truly outstanding number of features at a tremendous price saving. Shpg. Wt. 16 lbs.

SINE-SQUARE GENERATOR KIT

High quality sine and square waves are produced by this generator over a wide range. Frequency response is ± 1.5 db from 20 CPS to 1 mc on both sine and square waves, with less than .25% sine wave distortion, 20 to 20,000 CPS. Output impedance is 600 ohms on sine wave and 50 ohms on square wave (except on 10 volt range). Square wave rise time less than .15 microseconds. Five-position bandswitch—continuously variable tuning—shielded oscillator circuit—separate step and variable output attenuators in ranges of 10, 1 and .1 volts with extra range of .01 volt on sine wave. Shpg. Wt. 12 lbs.

20,000 OHMS/VOLT VOM KIT

This meter is ideal for use in field applications where accuracy is important. Employs a 30 ua 4½" meter, and features 1% precision multiplier resistors for high accuracy. Requires no external power for operation (batteries supplied). Sensitivity is 20,000 ohms-per-volt DC and 3,000 ohms-per-volt AC. Measuring ranges are 0-1.5, 5, 50, 150, 500, 1500 and 5,000 volts AC and DC. Measures direct current in ranges of 0-150 ua, 15 ma, 150 ma, 500 ma and 15 a. Resistance multipliers are $\times 1$, $\times 100$ and $\times 10,000$. Covers -10 db to +65 db. Batteries and test leads are also included with this kit. Shpg. Wt. 6 lbs.

HANDITESTER KIT

Small enough to carry with you wherever you go, this fine handitester is ideal for use in portable applications when making tests away from the work bench or as an "extra" meter in the service shop, when the main instruments are occupied. The combination function-range switch simplifies operation. Measures AC or DC voltage from 0-10, 30, 300, 1000 and 3000 volts. Direct current ranges are 0-10 ma and 0-100 ma. Ohmmeter ranges are 0-3000 and 0-300,000. Top quality precision components employed throughout. Very popular with home experimenters and electricians. Shpg. Wt. 3 lbs.

with Low-Cost Dependable Heathkits



ETCHED CIRCUIT VTVM KIT

The fact that this instrument is outselling all other VTVM's says a great deal about its accuracy, reliability, and overall quality. The precision and quality of the components used in this VTVM cannot be duplicated at this price through any other source. Its attractive appearance as well as its performance will make you proud to own it. A large 4½" panel meter is used for indication, with clear, sharp calibrations for all ranges. Front panel controls consist of a rotary function switch and a rotary range selector switch, zero-adjust and ohms-adjust controls. Precision 1% resistors are used in the voltage divider circuit. An etched circuit board is employed for most of the circuitry, cutting assembly time and eliminating the possibility of wiring errors. It also assures duplication of laboratory instrument performance. This multi-function VTVM will measure AC voltage (RMS), AC voltage (peak-to-peak), DC voltage and resistance. There are 7 AC (RMS) and DC voltage ranges of 1.5, 5, 15, 50, 150, 500 and 1500. In addition there are 7 peak-to-peak AC ranges of 0-4, 14, 40, 140, 400, 1400 and 4,000. Seven ohmmeter ranges providing multiplying factors of $\times 1$, $\times 10$, $\times 100$, $\times 1000$, $\times 10\text{ k}$, $\times 100\text{ k}$ and $\times 1$ megohm. Center scale resistance readings are 10, 100, 1000, 10 k, 100 k ohms, 1 megohm and 10 megohms. A zero-center scale db range is also provided. Battery and test leads included with kit. Shpg. Wt. 7 lbs.



HEATHKIT
V-7A

\$25.95

World's largest selling VTVM kit

- ★ LARGE EASY-TO-READ 4½" 200 UA METER
- ★ 1% PRECISION RESISTORS EMPLOYED FOR HIGH ACCURACY



HEATHKIT
C-3 \$19.50

Checks all types of condensers accurately



HEATHKIT
T-4 \$19.95

Locate faults quickly by tracing signals



HEATHKIT
SG-8 \$19.50

Easy-to-build—prewound and calibrated coils

CONDENSER CHECKER KIT

Check unknown condenser and resistor values quickly and accurately. Capacity measurements are made in four ranges of .00001 mfd-.005 mfd; .001 mfd-.5 mfd; 1 mfd-50 mfd; 20 mfd-1,000 mfd. Checks paper, mica, ceramic, and electrolytic condensers. Leakage test provides switch selection of five polarizing voltages, 25 volts to 450 volts DC to indicate condenser operating quality under actual load conditions. Electron beam "eye" tube indicates balance and leakage. A spring return test switch automatically discharges condenser under test and eliminates shock hazard to the operator. Measures resistance from 100 ohms to 5 megohms in two ranges. Shpg. Wt. 7 lbs.

VISUAL-AURAL SIGNAL TRACER KIT

Here is a brand new signal tracer completely redesigned with compact dimensions and new circuit layout. Features built-in speaker and electron beam "eye" tube for signal indication and a unique noise locator circuit. Ideal for use in AM, FM and TV circuit investigation. RF and audio inputs are provided in one convenient probe with switch on probe to select either input. Useful for checking microphones, phonograph cartridges, record changers, timers, etc. Makes a handy substitution speaker for servicing TV sets at the shop. Transformer operated for safety and high efficiency. Complete with test leads and informative construction manual. Shpg. Wt. 6 lbs.

RF SIGNAL GENERATOR KIT

Save valuable time in aligning RF tuned circuits of all kinds with this easy-to-use kit. Also a quick way to trace signals in faulty RF, IF and audio circuits. Designed for general service applications—the SG-8 covers 160 kc to 110 mc on fundamentals in five bands, and from 110 mc to 220 mc on calibrated harmonics. The entire oscillator circuit is built on a special sub-chassis, using prewound and calibrated coils. No further calibration is required so it is ready to use as soon as construction is completed. RF output is in excess of 100,000 microvolts, controlled by both step and continuously variable controls. Complete with output cable and instructions. Shpg. Wt. 8 lbs.

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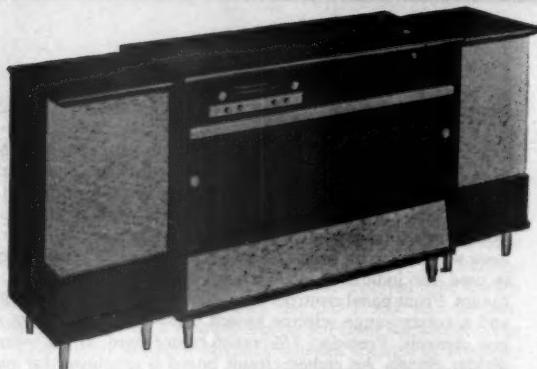
Enjoy Rich 3 Dimension Sound...

Beautifully Styled with Plenty of Room for the Most Complete Stereo System

AVAILABLE IN THE FOLLOWING MODELS:
Model SE-1B—Stereo Equipment Cabinet (birch)
Model SE-1M—Stereo Equipment Cabinet (mahogany)

Model SC-1BR—Stereo Wing Speaker Enclosure (birch—right end)
Model SC-1BL—Stereo Wing Speaker Enclosure (birch—left end)
Model SC-1MR—Stereo Wing Speaker Enclosure (mahogany—right end)
Model SC-1ML—Stereo Wing Speaker Enclosure (mahogany—left end)

\$149.95
\$39.95

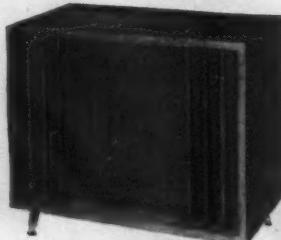


STEREO EQUIPMENT CABINET KIT

Imagine!... Stereophonic sound in your own home. This superbly designed cabinet holds all of your hi-fi stereo equipment and lends striking elegance to your living room. The attractive gold and black panels, trim and hardware brilliantly highlight the overall effect. Rich toned grille cloth, flecked in gold and black, complement the cabinet. The unit has ample room provided for an AM-FM tuner, tape deck, stereo preamplifier, amplifiers, record changer, record storage and speakers. Beautifully grained 1" solid core Philippine mahogany or select birch plywood is used for construction. The top features a shaped edge and sliding top panel for easy access to the stereo tape deck and stereo preamplifier. Sliding doors are employed for convenient front access to the

changer and record storage compartment. All parts of the cabinet are precut and predrilled for simple assembly. The speaker wings and center cabinet may be purchased separately if desired. Note: the kit is delivered equipped with panels pre-cut to accommodate Heathkit components and also blank panels to cut out for your own equipment. Measurements of the individual component areas follow: tape deck and preamplifier area 20 $\frac{1}{4}$ " L x 17 $\frac{1}{4}$ " W x 10" D., record changer area 21" W. x 16" D. x 9 $\frac{1}{2}$ " H., record storage area 22 $\frac{1}{2}$ " W. x 14 $\frac{1}{2}$ " H. x 12 $\frac{1}{2}$ " D., speaker wing area (inside) 14" W. x 29 $\frac{1}{2}$ " H. x 15 $\frac{1}{2}$ " D., AM-FM Tuner area 20 $\frac{1}{2}$ " W. x 5 $\frac{1}{4}$ " H. x 14" D., amplifier (2 areas) 15 $\frac{1}{4}$ " W. x 10 $\frac{1}{4}$ " H. x 13 $\frac{1}{4}$ " D.

Model HH-1B Birch
Model HH-1M Mahogany
New only **\$299.95** each



**The Same Superior Performance
At a New Low Price**

**HEATHKIT
SS-2 \$39.95**

**OPTIONAL LEGS
EXTRA**

Economical Hi-Fi For Your Home

"LEGATO" HI-FI SPEAKER SYSTEM KIT

The increasing sales of the Legato has made more economical quantity production possible so we are passing the savings on to you by offering you this magnificent speaker system at a reduced price. Truly a "queen" among hi-fi speaker systems, the Legato was specially designed to meet and surpass the most stringent requirements of high fidelity sound reproduction. Two 15" Altec Lansing low frequency drivers cover frequencies of 25 to 500 CPS while a specially designed exponential horn with high frequency driver covers 500 to 20,000 CPS. A unique crossover network is built in making electronic crossovers unnecessary. Internal reflections are absorbed by splayed back panel and a 3" fiber glass lining. The Legato emphasizes simplicity of line and form to blend with modern or traditional furnishings. Cabinet construction is $\frac{3}{4}$ " veneer surface plywood in either African mahogany or white birch and measures 41" L. x 22 $\frac{1}{4}$ " D. x 34" H. All parts are precut and predrilled for easy assembly. Shpg. Wt. 195 lbs.

"BASIC RANGE" HI-FI SPEAKER SYSTEM KIT

True high fidelity performance at modest cost make this basic speaker system a spectacular buy for any hi-fi enthusiast. The amazing performance of this popular kit is made possible by the use of high quality speakers in an enclosure specially designed to receive them. The cabinet is a ducted port bass reflex type enclosure 11 $\frac{1}{2}$ " H. x 23" W. x 11 $\frac{1}{4}$ " D. It features an 8" mid range woofer to cover 50 to 1600 CPS and a compression-type tweeter with flared horn covering 1600 to 12,000 CPS. Both speakers are by Jensen. The adjustable flared tweeter horn allows speaker to be used in either upright or horizontal position. The cabinet is constructed of $\frac{1}{2}$ " veneer surfaced plywood suitable for light or dark finish of your choice. All wood parts are precut and pre-drilled for easy assembly. Shpg. Wt. 25 lbs.

Attractive brass tip accessory legs convert SS-2 into attractive console. Legs screw into brackets provided. All hardware included. Shpg. Wt. 3 lbs. No. 91-26 \$4.95

with a Heathkit Stereo System

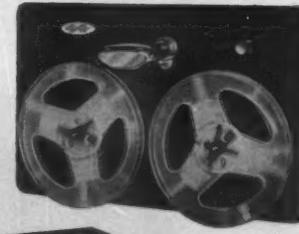


HIGH FIDELITY TAPE RECORDER KIT

Popular request for high quality, low cost tape recording and playback facilities have prompted the addition of this fine unit to our line. The TR-1A provides monaural record/playback with fast forward and rewind functions. Incorporates separate erase and combination record/playback heads. Two speeds, $7\frac{1}{2}$ and $3\frac{3}{4}$ IPS, are selected by changing belt drive. Flutter and wow are held to less than 0.35%. Frequency response at $7\frac{1}{2}$ IPS ± 2.0 db 50-10,000 CPS, at $3\frac{3}{4}$ IPS ± 2.0 db 50-65,000 CPS. The extremely simple mechanical assembly is ideally suited to kit construction. One control lever selects all functions on deck, greatly simplifying operation. Mount in vertical or horizontal position. The model TE-1 record/playback tape preamplifier, supplied with the mechanical assembly, provides NARTB playback equalization. A record interlock prevents accidental tape erasure. Recording level is indicated by a 6E5 "magic eye" tube. A two-position input selector switch provides for mike or line input. Separate record and playback gain controls. Filament balance control allows adjustment for minimum hum level. Cathode follower output from playback channel is approximately 600 ohms impedance. Two circuit boards are used for easy assembly. Templates and instructions are provided to cut out panels for mounting. Overall dimensions of tape deck and preamp are $15\frac{1}{2}$ " W. x $13\frac{1}{2}$ " H. x 8" D. Signal-to-noise ratio is better than 45 db below normal recording level with less than 1% total harmonic distortion. (Tape mechanism not sold separately.) Shpg. Wt. 22 lbs.

TAPE RECORDER ELECTRONICS KIT

The model TE-1 Electronics Kit can be purchased separately to replace the electronics in your present tape recorder, or used in addition to it for stereo playback of pre-recorded tapes where a second playback channel is required. Circuit may be modified for use with different head types. Shpg. Wt. 9 lbs.

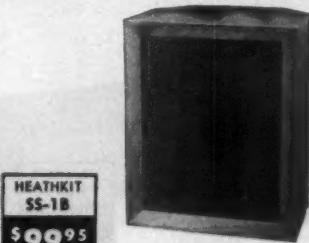


**HEATHKIT
TR-1A \$99.95**

(Includes tape deck, tape recorder electronics, mike and roll of tape.)

Make Your Own Home Recordings

**HEATHKIT
TE-1
\$39.95**



**HEATHKIT
SS-1B
\$99.95**

**Fill out the Hi-Fi Range
of Your SS-2 Speaker**



**HEATHKIT
SW-1 \$24.95**

Save Time Rewinding Tape



**HEATHKIT
TK-1 \$9.95**

**All The Tools You Need For
Building Heathkits**

“ORANGE EXTENDING” HI-FI SPEAKER SYSTEM KIT

This is not a complete speaker system in itself, but is designed to extend the range of the SS-2. The SS-1B uses a 15" woofer and a small super tweeter to supply the very high and very low frequencies to fill out the response of the basic SS-2. The SS-2 and SS-1B when used together, form an integrated four-speaker system. The SS-2 and SS-1B combination provide an overall response of ± 5 db from 35 to 16,000 CPS. The kit includes circuit for crossover at 600, 1600 and 4,000 CPS. Impedance is 16 ohms and power rating is 35 watts. A control is also provided to limit output of super tweeter. The handsome cabinet measures 29" H. x 23" W. x $17\frac{1}{2}$ D. Constructed of beautiful $\frac{3}{4}$ " veneer surface plywood. Complete step-by-step instructions make this kit easy to build. No wood-working experience required. Shpg. Wt. 80 lbs.

“SPEEDWINDER” KIT

This handy device leaves your tape recorder free for operation while it rewinds tape at the rate of 1200' in 40 seconds. Prevents unnecessary wear to the tape and recorder by eliminating wear against guides and heads. It will handle up to $10\frac{1}{4}$ " tape reels as well as 800' reels of 8 and 16 millimeter film. A very useful aid to operators of movie projection equipment. The Heathkit Speedwinder features an automatic shutoff which prevents whipping of tape when it has rewound. A manual shutoff is also provided. An automatic braking device is built in for protection against power failure. Driven by a heavy duty four pole motor. Handsome cabinet is constructed of furniture grade plywood. Step-by-step instructions are provided to make this kit easy to assemble even by one with no experience. Shpg. Wt. 12 lbs.

COMPLETE TOOL SET

A clear illustration of just how easy Heathkit building is. The pliers, diagonal sidecutters, two screw drivers and soldering iron are all the basic tools you need for building practically any Heathkit. Pliers and sidecutters are equipped with insulated rubber handles. The American Beauty soldering iron has a replaceable tip to facilitate cleaning. All the tools are of top quality case hardened steel for rugged duty and long life. With these simple, inexpensive tools in your hand you need not be afraid to tackle the most elaborate kit. The manual included with this handy kit provides you with many useful tips on the use and care of your tools. It shows the all important step of making proper solder connections. A truly worthwhile investment for the beginner in electronic kit building. Shpg. Wt. 3 lbs.

HEATH COMPANY • a subsidiary of Daystrom, Inc. • Benton Harbor 15, Mich.



Plan Your Hi-Fi System...



**HEATHKIT
SP-2** **\$56.95**

Model SP-1 (monaural)
\$37.95

Model C-SP-1 (converts SP-1 to SP-2)
\$21.95

**Control both stereo
channels simply
and conveniently**

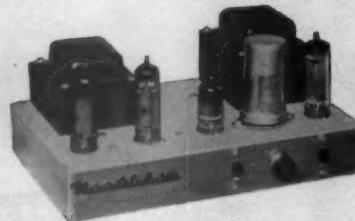
MONAURAL-STEREO PREAMPLIFIER KIT

This expertly designed preamplifier provides all the controls required for either standard monaural (single channel) or stereo (dual channel) sound reproduction. Features building block design... you can start with a basic preamplifier and add a second channel for stereo later on, without rewiring. Second channel plugs in for fast conversion. The complete model SP-2 (stereo) features twelve separate inputs, six on each channel with input level controls. Six dual-concentric controls consist of: two 8-position selector switches, two bass, two treble, two volume level and two loudness controls, a scratch filter switch and a 4-position function switch (separate on-off switch). The function switch provides settings for stereo, two-channel mix, channel A or B for monaural use. Inputs consist of tape, mike, mag phono and three high-level inputs. Tape input has NAKTB equalization and input selector provides for RIAA, LP, 78 record compensation. EF86 tubes are used in the input stages along with hum balance controls to assure low hum and noise. Two cathode follower outputs with level controls provided in addition to two separate tape outputs for stereo recording. A remote balance control with twenty feet of cable allows balancing the stereo system from listening position. Construction is greatly simplified through the use of two printed circuit boards (one in each channel) and encapsulated printed circuits. The beautiful vinyl clad steel cover has leather texture in black with inlaid gold design. Built-in power supply.



**HEATHKIT
WA-P2** **\$19.75**

**Finger-tip controls for
your operating convenience**



**HEATHKIT
UA-1** **\$21.95**

**A low cost
versatile performer**

"MASTER CONTROL" PREAMPLIFIER KIT

Designed as a control center for basic amplifiers the WA-P2 provides you with true high fidelity performance for the finest audio systems. Five switch-selected inputs accommodate a record changer, tape recorder, AM-FM tuner, TV receiver, microphone, etc., each with level control. Provision is also made for a tape recorder output. Ideal for "remote" installations, the WA-P2 features a low impedance cathode-follower output circuit allowing greater length of output lead. Full frequency response is obtained within $\pm 1\frac{1}{2}$ db from 15 to 35,000 CPS and will do full justice to the finest available program sources. Equalization is provided for records through separate turnover and rolloff switches for LP, RIAA, AES, and early 78's. A special hum balance control allows setting for minimum hum level. Power for operation is required from basic amplifier or external source. Shpg. Wt. 7 lbs.

With Flexible Heathkit Components



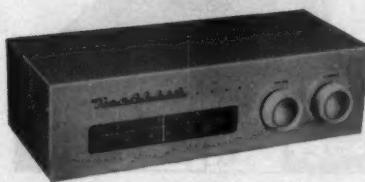
DELUXE AM-FM TUNER KIT

Outstanding features in both styling and circuitry are combined in this 16-tube deluxe AM-FM combination tuner to bring you the very finest in program sources, for your listening enjoyment. Features include three circuit boards for easy construction and high stability—prewired, prealigned FM front end—built-in AM rod antenna—tuning meter—AFC (automatic frequency control) with on-off switch and flywheel tuning. AM and FM circuits are separate and individually tuned making it ideal for stereo applications. Cathode follower outputs with individual controls are provided for both AM and FM. Other features include variable AM bandwidth, 10 kc whistle filter, tuned-cascode FM front end, FM AGC and amplified AVC for AM. The unique IF limiter design automatically provides the number of limiting and IF stages required for smooth non-flutter reception. The silicon diode power supply is extremely conservatively rated and is fuse protected assuring long service life. A tuning meter shows when the station is tuned-in for clearest reception on AM or FM. Use of three circuit boards greatly simplifies construction of circuit, you do only a minimum of wiring. All IF transformers and coils are prealigned so it will be ready to operate as soon as construction is completed. Appearance of this top-quality unit is further enhanced by the vinyl-clad steel cover in black with inlaid gold design. A multiplex jack is provided for addition of converter unit to receive multiplex stereo broadcasts on FM. A top dollar value.



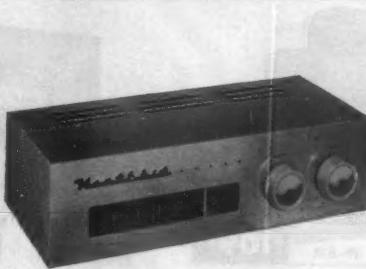
HEATHKIT
PT-1 \$89.95

**A deluxe AM-FM
tuner combination
loaded with extras!**



HEATHKIT
BC-1A \$26.95

Wide range broadcast reception



HEATHKIT
FM-3A \$26.95

Enjoy static-free FM entertainment

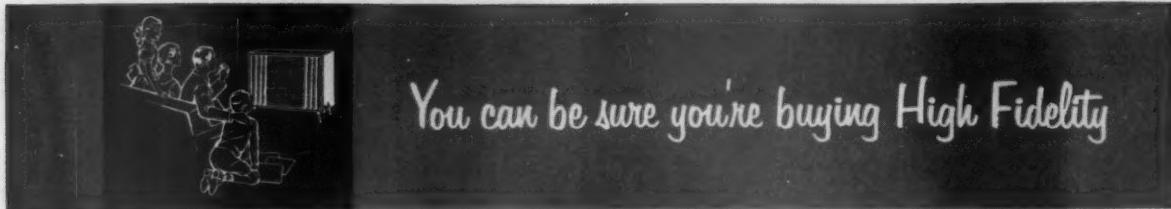
HIGH FIDELITY AM TUNER KIT

This AM tuner was designed especially for high fidelity applications. It incorporates a special detector using crystal diodes, and the IF circuit features broad bandwidth to assure low signal distortion. Audio response is ± 1 db from 20 CPS to 9 kc, with 5 db of pre-emphasis at 10 kc to compensate for station rolloff. Sensitivity and selectivity are excellent and the tuner covers the entire broadcast band from 550 to 1600 kc. Quiet performance is assured by a 6 db signal-to-noise ratio at 2.5 uv. Prealigned RF and IF coils eliminate the need for special alignment equipment. Incorporates AVC, two outputs, two antenna inputs, and built-in power supply. Edge-lighted glass slide rule dial for easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 9 lbs.

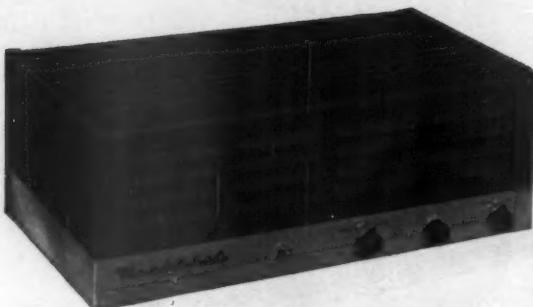
HIGH FIDELITY FM TUNER KIT

FM programming, your least expensive source of high fidelity will provide you with years of real enjoyment. This beautifully styled FM tuner features broad-banded circuits for full fidelity and better than 10 uv sensitivity for 20 db of quieting to pull in stations with clarity and full volume. Covers the complete FM band from 88 to 108 mc. Stabilized, temperature-compensated oscillator assures negligible drift after initial warmup. A ratio detector provides high-efficiency demodulation without sacrificing hi-fi performance. IF and ratio transformers are prealigned, as is the front end tuning unit, making special alignment equipment unnecessary. Edge-lighted glass slide rule dial for easy tuning. You need not wait to have FM in your home at this low price. Shpg. Wt. 8 lbs.

HEATH COMPANY • a subsidiary of Daystrom, Inc. • Benton Harbor 15, Mich.



You can be sure you're buying High Fidelity



HEATHKIT
W-7M

\$54.95

**55 watts of hi-fi power at
only \$1 per watt**

- ★ BEAUTIFULLY STYLED IN BLACK AND GOLD
- ★ UNITY OR MAXIMUM DAMPING

**"EXTRA PERFORMANCE"
55 WATT HI-FI AMPLIFIER KIT**

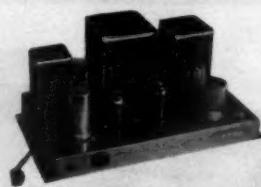
Another Heathkit first! An honestly rated high power amplifier with many top quality features at less than a dollar per watt. Full audio output is conservatively rated at 55 watts from 20 CPS to 20 kc with less than 2% total harmonic distortion throughout the entire range. Unique paired output connections permit instant switch selection of "unity" or "maximum" damping factors for all 4, 8 or 16 ohm speakers. Each output has an optimized current feedback circuit for unity damping so that there will be no compromise in performance when any of the impedances is used. This current feedback circuitry is entirely shorted out when not in use to obtain the highest possible damping factor. Features include level control and "on-off" switch right on the chassis plus provision for remote control from preamp, etc. Famous "bas-bal" circuit conveniently balances EL-34 output tubes. These heavy duty push-pull tubes operate into a high quality tapped-screen transformer designed especially for this unit. A 70-volt output on the transformer provides for P.A. or large music systems. The silicon diode power supply features a protection device that controls current until tubes have warmed up, greatly increasing service life of all components. The stylish black and gold case measures 6" H. x 8½" D. x 15" W. Convenient pilot light on the chassis. Thoughtful circuit layout makes this kit easy to build. Dollar for watt you can't beat this buy. Shipped express only. Shpg. Wt. 28 lbs.



HEATHKIT
W-6M \$109.95



HEATHKIT
W-5M \$59.75



HEATHKIT
W-4-AM \$39.75

**Plenty of Reserve Power
Without Distortion**

**Top-Flight Performance
for the Critical Listener**

**Faithful Sound Reproduction
with Minimum Investment**

"HEAVY DUTY" 70-WATT HI-FI AMPLIFIER KIT

Here is an amplifier that will provide the extra "push" needed to drive any of the fine speaker systems available today, for truly fine performance at any power level. Silicon-diode rectifiers are used to assure long life and a heavy duty transformer gives you extremely good power supply regulation. Variable damping control provides optimum performance with any speaker system. Quick change plug selects 4, 8 and 16 ohms or 70 volt output and the correct feedback resistance. Frequency response at 1 watt is from 5 CPS to 80 kc with controlled HF rolloff above 100 kc. At 70 watts output harmonic distortion is below 2%, 20 to 20,000 CPS and IM distortion is below 1%. 60 and 6,000 CPS. Hum and noise 88 db below full output. Metered balance circuit. Designed especially for easy assembly and years of dependable service. Shipped express only. Shpg. Wt. 52 lbs.

25-WATT HI-FI AMPLIFIER KIT

Considered top value in its power class by leading independent research organizations, the W-5M incorporates all the design features required by the super critical listener. Features include a specially designed Peerless output transformer and KT66 tubes. The circuit is rated at 25 watts and will follow instantaneous power peaks of a full orchestra up to 42 watts. A "tweeter saver" suppresses high frequency oscillation and a new type balancing circuit facilitates adjustment of the "dynamic" balance between output tubes. Frequency response is ± 1 db from 5 CPS to 160,000 CPS at 1 watt and within 2 db from 20 to 20,000 CPS at full 25 watts output. Harmonic distortion is less than 1% at 25 watts and IM distortion is 1% at 20 watts (60 and 3,000 CPS, 4:1). Hum and noise are 99 db below 25 watts for truly quiet performance. Rich black and gold colored styling. Shipped express only. Shpg. Wt. 31 lbs.

20-WATT HI-FI AMPLIFIER KIT

This fine amplifier will amaze you with its outstanding performance. It features a true Williamson circuit with extended frequency response, low distortion, and low hum levels. Enjoy true hi-fi with only a minimum investment compared to other units on the market. 5881 tubes and a special Chicago-Standard output transformer are employed to give you full fidelity at minimum cost. Frequency response extends from 10 CPS to 100 kc within ± 1 db at 1 watt assuring you of full coverage of the audio range. Clean, clear sound amplification takes place in circuits that hold harmonic distortion at 1.5% and IM distortion below 2.7% at full 20 watt output. Hum and noise are 95 db below full output. Taps on the output transformer are at 4, 8 or 16 ohms to match the speaker system of your choice. An outstanding performer, this investment will bring you years of listening enjoyment. Shipped express only. Shpg. Wt. 28 lbs.

All basic amplifiers recommended for use with model WA-P2, SP-1 or SP-2 preamplifiers

...When You Buy Heathkits



"BOOKSHELF" 12-WATT AMPLIFIER KIT

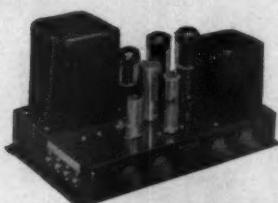
The model EA-2 combines eye-pleasing style and color with many extra features for high quality sound reproduction. This fine amplifier provides full range frequency response from 20 to 20,000 CPS within ± 1 db. Harmonic distortion is less than 1% at full 12 watt output over the entire range (20-20,000 CPS). IM distortion is less than 1.5% at 12 watts with low hum and noise. Miniature tubes are used throughout the advanced circuitry, including EL84 output tubes in a push-pull tapped-screen output circuit using a special designed output transformer. Transformer has taps at 4, 8 and 16 ohms. The model EA-2 has its own built-in preamplifier with provision for three separate inputs, mag phono, crystal phono and tuner. The mag phono input features RIAA equalization. Separate bass and treble controls are provided with boost and cut action. A special hum-balance control assures quiet operation. The luxury styled cabinet has a smooth simulated leather texture in black with inlaid gold design and is constructed of vinyl plastic bonded to steel. It resists scuffing, wear, abrasion, and chemicals. The front panel features brushed-gold trim and buff knobs with gold inserts for a very pleasing appearance. An amber neon pilot lamp indicates when the amplifier is on. Cabinet measures 12½" W. x 3¾" D. x 4¾" H. making it suitable for use on a bookshelf, end table, etc. High quality is emphasized throughout for performance matching amplifiers costing many times more. Shpg. Wt. 15 lbs.



HEATHKIT
EA-2 \$28.95

**Combines beauty, style
and quality**

- ★ LESS THAN 1% DISTORTION AT FULL OUTPUT OVER ENTIRE AUDIO RANGE.
- ★ BUILT-IN PREAMPLIFIER



HEATHKIT
A9-C \$35.50

**A Bargain Package of
Power and Performance**



HEATHKIT
AV-3 \$29.95

**Invaluable for
Hi-Fi Testing**



HEATHKIT
AW-1 \$29.50

**Measure Exact
Power Output**

GENERAL-PURPOSE 20-WATT AMPLIFIER KIT

The A9-C combines a preamplifier, main amplifier and power supply all on one chassis providing a compact unit to fill the need for a good high fidelity amplifier with a moderate cash investment. Designed primarily for home installations, it is also capable of fulfilling P.A. requirements. The preamplifier section features four separate switch selected inputs. Separate bass and treble tone controls offer 15 db boost and cut. A true high fidelity performer, the A9-C covers 20 to 20,000 CPS within ± 1 db. Front panel is detachable, and can be installed on the outside of a cabinet where the chassis comes through, for custom installations. A fine unit with which to start your hi-fi system. Shpg. Wt. 23 lbs.

AUDIO VTVM KIT

Critical AC voltage measurements are made easy with this high quality vacuum tube voltmeter which emphasizes stability, broad frequency response and sensitivity. Features large 4½" 200 microampere meter, with increased damping in the meter circuit for stability in low frequency tests. Extremely high voltage range handles measurements from a low value of 1 millivolt to a maximum of 300 volts. AC (RMS) voltage ranges are: 0-0.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts. Db ranges cover -52 to +52 db. Employs 1% precision multiplier resistors for maximum accuracy. High input impedance (1 megohm at 1,000 CPS). Frequency response is essentially flat from 10 CPS to 200 kc. Shpg. Wt. 6 lbs.

AUDIO WATTMETER KIT

Here is a fine meter to accurately measure output wattage. Five power ranges cover 0-5 mw, 50 mw, 500 mw, 5 w and 50 w full scale. Five switch selected db ranges cover -10 db to +30 db. All indications are read directly on the large 4½" 200 ua meter. Frequency response is ± 1 db from 10 CPS to 250 kc. External or internal load resistors are selected with convenient front panel switch. Non-inductive load resistors are built in for 4, 8, 16 or 600 ohms impedance. Precision multiplier resistors are used for high accuracy and incorporates a crystal diode bridge for wide-range frequency response. Modern styling and convenient front panel design. Cabinet is ventilated to allow efficient cooling of load resistors. Shpg. Wt. 7 lbs.

HEATH COMPANY • a subsidiary of Daystrom, Inc., • Benton Harbor 15, Mich.



Easy to Buy - Easy to Build - Easy to Use...



**Combine all your Hi-Fi equipment
in this attractive cabinet**

CHAIRSIDE ENCLOSURE KIT

This Chairside Enclosure lets you combine all of your hi-fi equipment into one compact control center and, at the same time add a beautiful piece of furniture to your home. The CE-1 is designed to house the AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier along with the majority of record changers which will fit into the space provided. Adequate room is available in the rear of the unit to house any of the Heathkit amplifiers designed to operate with the WA-P2. The enclosure is flexible enough to give you a large choice in component installation. If only one tuner and the preamplifier are used, the two units can be installed in the tilt-out drawer; or if more convenient, either unit can be placed in the space provided in front of the changer compartment. The tilt-out shelf can be installed on either right or left side and the lift-top lid is similarly designed to lift from either side depending on your choice during construction. Good ventilation is achieved through appropriately placed slots in the bottom and back of the enclosure. Overall dimensions are 18" W. x 24" H. x 35½" D. The changer compartment measures 17¾" L. x 16" W. x 9¾" D. All parts are precut and predrilled for easy assembly and attractive hardware is supplied to match each style. The contemporary cabinet is available in either mahogany or birch and the traditional cabinet is available in mahogany only. Furniture grade plywood can be finished to your taste. Shpg. Wt. 46 lbs.



HEATHKIT
AG-9A \$34.50

Your own source of
Hi-Fi audio signals



HEATHKIT
AA-1 \$49.95

3 Audio test instruments
in one compact unit



HEATHKIT
HD-1 \$49.50

Check amplifier
distortion quickly

AUDIO SIGNAL GENERATOR KIT

The model AG-9A is "made to order" for high fidelity applications, and provides quick and accurate selection of low-distortion signals from 10 CPS to 100 kc. Three rotary switches select two significant figures and a multiplier to determine audio frequency. Incorporates step-type and a continuously variable output attenuator. Output indicated on large 4½" panel meter, calibrated in volts and db. Attenuator system operates 10 db steps, corresponding to meter calibration, in ranges of 0-.003, .01, .03, .1, .3, 1, 3 and 10 volts RMS. "Load" switch permits use of built-in 600-ohm load, or external load of different impedance. Output and frequency indicators accurate to within ±5%. Distortion less than .1 of 1% between 20 and 20,000 CPS. Shpg. Wt. 8 lbs.

AUDIO ANALYZER KIT

Complete high fidelity testing facilities are yours in the AA-1. It combines the functions of three separate instruments; an AC VTVM, audio wattmeter and a complete 1M analyzer with filters and high and low frequency oscillators built in. VTVM ranges are: 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts (RMS). Db scale reads from -65 to +52 dbm. Wattmeter ranges are: .15 mw, 1.5 mw, 15 mw, 150 mw, 1.5 w, 15 w and 150 w. 1M scales are 1%, 3%, 10%, 30% and 100% full scale. Provides internal load resistors of 4, 8, 16 or 600 ohms. Combining and consolidating functions reduces the number of test leads and controls required for the same test. Complete instructions are provided for easy assembly, also valuable information on use of instrument. Shpg. Wt. 13 lbs.

HARMONIC DISTORTION METER KIT

Valuable in both designing and servicing of audio circuits, the HD-1 used with an audio signal generator, will accurately measure harmonic distortion at any or all frequencies between 20 and 20,000 CPS. Distortion is read on panel meter in ranges of 0-1, 3, 10, 30 and 100% full scale. Full scale voltage ranges of 0-1, 3, 10 and 30 volts are provided for the initial reference settings. Signal-to-noise ratio is measured on a separate meter scale calibrated in db. Features high input impedance (300,000 ohms) and 1% precision resistors in the VTVM voltage divider circuit for excellent sensitivity and accuracy. High quality components insure years of dependable service. Complete instructions provided for easy assembly and operation. Shpg. Wt. 13 lbs.

Heathkits are Your Best Dollar Value



TRANSISTOR PORTABLE RADIO KIT

The overwhelming sales of this outstanding transistor portable have made a substantial price reduction possible... in addition, an all new plastic molded case adds the finishing touch to the exceptional circuitry. Six name-brand (Texas Instrument) transistors are used for extra good sensitivity and selectivity. The 4" x 6" PM speaker with heavy magnet provides excellent tone quality. Use of this large speaker and roomy chassis make it unnecessary to crowd components adding greatly to the ease of construction. Transformers are prealigned so it is ready for service as soon as construction is completed. A touchup in alignment is easily accomplished on a station by following simple instructions in manual. Alignment tool furnished. Has built-in rod-type antenna for reception in all locations. Six standard size "D" flashlight cells are used for extremely long battery life (between 500 and 1000 hours) and they can be purchased almost anywhere. Cabinet is two-tone blue molded plastic with pull-out carrying handle. Dimensions are 9½" L. x 7¼" H. x 4" D. Shpg. Wt. 6 lbs.

Model XR-1-L: Identical to XR-1-P except in genuine leather case. Rich, warm sun-tan tone. Leather carrying strap included. Shpg. Wt. 7 lbs.

Leather Case: can be purchased separately if desired. Fits all XR-1P's and XR-1's. No. 93-1. Shpg. Wt. 3 lbs. \$6.95.



MODEL XR-1-L
\$34.95

HEATHKIT
XR-1-P
\$29.95

Newly designed plastic case . . . new low price!

- ★ 4" X 6" SPEAKER FOR "BIG SET" TONE
- ★ LONG BATTERY LIFE (500 to 1000 Hours)



HEATHKIT
CT-1
\$7.95



HEATHKIT
DF-1
\$54.95

Test condensers right in the circuit

Pin-point your exact location



HEATHKIT
FD-1
\$35.95 each
(6 volt model FD-1-6)
(12 volt model FD-1-12)

Detected gas fumes



HEATHKIT
MC-1
\$42.95

Save your boat batteries

IN-CIRCUIT CAPACI-TESTER KIT

Check most capacitors for "open" or "short" right in the circuit with this handy kit. Detects open capacitors from about 50 mmf up, not shunted by an excessively low resistance value. Checks shorted capacitors up to 20 mfd (not shunted by less than 10 ohms). (Does not detect leakage nor check electrolytic capacitors.) Employs a 60-cycle frequency for the short test and a 19 megacycle frequency for the "open" test. Uses electron beam "eye" tube for quick indication. Test leads included. Shpg. Wt. 5 lbs.

TRANSISTOR RADIO DIRECTION FINDER KIT

This transistor radio compass will double as a portable radio. Covers the standard broadcast band from 540 to 1600 kc. Ideal for use aboard boats and also on land by hunters, hikers, etc. A directional high-Q ferrite antenna rotates from the front panel to obtain a fix on a station. A 1 ma meter serves as null and tuning indicator. Prealigned IF transformers—six transistor circuit. Powered by tiny 9-volt battery with spare included. Dimensions 7½" W. x 5¾" H. x 5¾" D. Shpg. Wt. 5 lbs.

FUEL VAPOR DETECTOR KIT

Protect your boat and passengers against fire and explosion with one of these fuel vapor detector kits. Indicates the presence of fumes on a three-color "safe-dangerous" meter scale and immediately shows if it is safe to start the engine. A pilot lamp shows when the detector is operating. Easy to build and install, even by one not having previous experience. Operates from your boat battery. The kit is complete with heavy-duty neoprene insulated cable and includes spare detector unit. Shpg. Wt. 4 lbs.

MARINE CONVERTER KIT

Charge 6 or 12 volt batteries with this marine converter and battery charger. A panel mounted 25 ampere meter continuously monitors the charging current. Moisture and fungus proofed for rugged marine use. Convection cooling prevents unsafe temperature rise. The MC-1 has no moving parts, tubes nor blowers to wear out or break. Mounting brackets are supplied for easy installation on any boat. Ideal for keeping batteries fully charged or to supply extra current for appliances. Shpg. Wt. 16 lbs.

HEATH COMPANY • a subsidiary of Daystrom, Inc. • Benton Harbor 18, Mich.



New Styling - New Features...



HEATHKIT
TX-1 \$22950

Complete Versatility for Top-Notch Amateur Communications

- ★ NEWLY DESIGNED VFO—ROTATING SLIDE RULE DIAL
- ★ MODERN STYLING—PROVISION FOR SSB ADAPTER

"APACHE" HAM TRANSMITTER KIT

Fresh out of the Heath Company laboratories, the brand-new "Apache" model TX-1 ham transmitter features modern styling and the latest in circuitry for extra fine performance. The "Apache" is a high quality transmitter operating with a 150 watt phone input and 180 watt CW input. In addition to CW and phone operation, built-in switch selected circuitry provides for single-sideband transmission through the use of a plug-in external adapter. These SSB adapters will be available in the near future. A compact, stable and completely redesigned VFO provides low drift frequency control necessary for SSB transmission. A slide rule type illuminated rotating VFO dial with vernier tuning provides ample bandspread and precise frequency settings. The bandswitch allows quick selection of the amateur bands on 80, 40, 20, 15 and 10 meters. (11M with crystal control). This unit also has adjustable low level speech clipping and a low distortion modulator stage employing two of the new 6CA7/EL-34 tubes in push-pull class AB operation. Time sequence keying is provided for "chirpless" break-in CW operation. The final amplifier is completely shielded for greater TVI protection and transmitter stability. Die-cast aluminum knobs and front panel escutcheons add to the attractive styling of the transmitter. Pi network output coupling matches antenna impedances between 50 and 72 ohms. Shpg. Wt. 107 lbs.

\$50.00 deposit required on C.O.D. orders. Shipped motor freight unless otherwise specified.



HEATHKIT
DX-20 \$3595

An Ideal
Code Transmitter



HEATHKIT
DX-100 \$18950

You'll be Proud to Own
This Outstanding Performer



HEATHKIT
DX-40 \$6495

Phone & CW Facilities
at Low Cost

DX-20 CW TRANSMITTER KIT

Designed especially for CW work, the DX-20 features high efficiency at low cost. An ideal rig for the novice or advanced-class CW operator. Plate power input is 50 watts, and covers 80, 40, 20, 15, 11 and 10 meters with single knob bandswitching. Features a single 6DQ6A tube in the final amplifier stage and a 6CL6 as a crystal oscillator. Pi network output circuit matches various antenna impedances between 50 and 1000 ohms and reduces harmonic output. Top-quality parts are featured throughout, including "potted" transformers, etc., for long service life. Complete shielding to minimize TVI. Removable metal pull-out plug on left end of cabinet provides access for crystal changing. Very easy to build with complete instructions supplied. Shpg. Wt. 19 lbs.

DX-100 PHONE AND CW TRANSMITTER KIT

Well known for its high quality and fine performance the DX-100 features a built-in VFO, modulator, and power supply, complete shielding to minimize TVI, and a pi network coupling to match impedances from 50 to 600 ohms. RF output is in excess of 100 watts on phone and 120 watts on CW, for clean strong signals on all ham bands from 10 to 160 meters. Single knob bandswitching and illuminated VFO dial and meter face add real operating convenience. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1625's. High quality components are used throughout, such as potted transformers, silver-plated or solid coin silver switch terminals, aluminum-heat dissipating caps on the final tubes, copper plated chassis, etc. Shpg. Wt. 107 lbs.

\$50.00 deposit required on C.O.D. orders. Shipped motor freight unless otherwise specified.

DX-40 PHONE AND CW TRANSMITTER KIT

An outstanding buy in its power class the DX-40 provides both phone and CW operation on 80, 40, 20, 15, 11 and 10 meters. A single 6146 tube is used in the final amplifier stage to provide full 75 watt plate power input on CW, or controlled carrier modulation peaks up to 60 watts for phone operation. Modulator and power supplies are built in and single-knob bandswitching is combined with the pi network output circuit for complete operating convenience. Complete shielding to minimize TVI. Provision is made for three crystals. A four-position switch selects any of the three crystals or a jack for external VFO. Crystal sockets are reached through access door in rear of cabinet. High quality D'Arsonval movement panel meter. Shpg. Wt. 25 lbs.

For Real Ham Enjoyment



"MOHAWK" HAM RECEIVER KIT

Here is a ham receiver that any radio operator would be proud to own. The "Mohawk" has all the functions required for high quality communications with clear, rock-steady reception on all bands. This 15-tube receiver features double conversion with IF's at 1682 kc and 50 kc and covers all of the amateur frequencies from 160 through 10 meters on seven bands with an extra band calibrated to cover 6 and 2 meters using a converter. Receiver accommodations are provided for these converters which will be available in Heathkits soon. The "Mohawk" is specially designed for single-sideband reception with crystal controlled oscillators for upper and lower sideband selection. A completely preassembled, wired and aligned front end coil assembly assures ease of construction and top performance of the finished unit. Other features include five selectivity positions from 5 kc to 500 CPS, bridged T-notch filter for maximum heterodyne rejection, and a built-in 100 kc crystal calibrator. The set provides a 10 db signal-to-noise ratio at less than 1 microvolt input. Front panel features S meter, separate RF, IF and AF gain controls, T-notch tuning, T-notch depth, ANL, AVC, BFO, bandswitch, tuning, antenna trimmer, calibrate set, calibrate on, CW-SSB-AM, receive-standby, upper-lower sideband, selectivity, phone jack and a wide band rotating slide rule type vernier tuning dial with easy to read calibrations. Shpg. Wt. 67 lbs.

\$50.00 required on C.O.D. orders. Shipped motor freight unless otherwise specified.



HEATHKIT
RX-1 \$274.95

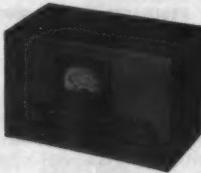
Now in Kit Form a Top Quality Ham Band Receiver

- ★ PREWIRED AND ALIGNED FRONT END COIL ASSEMBLY.
- ★ CRYSTAL CONTROLLED OSCILLATORS FOR DRIFT-FREE RECEPTION.



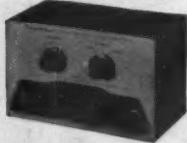
HEATHKIT
B-1 \$8.95

Get Proper Match Between Transmitter and Antenna



HEATHKIT
AM-2 \$15.95

Measure Standing Wave Ratio



HEATHKIT
VX-1 \$23.95

Eliminates Hand Switching



HEATHKIT
PM-1 \$14.95

Quick Check of Transmitter Operation

BALUN COIL KIT

Unbalanced coax lines used on the most modern transmitters can be matched to balance lines of either 75 or 300 ohms impedance by using the model B-1 Balun Coil Kit. Can be used with transmitters and receivers without adjustment over the frequency range of 80 through 10 meters, and will handle power inputs up to 200 watts. Cabinet size is 10" square by 5" D, and may be located any distance from the transmitter or antenna. A protective cover is supplied to prevent damage in outdoor installations. Shpg. Wt. 4 lbs.

REFLECTED POWER METER KIT

The match of your antenna transmission system can be checked by measuring the forward and reflected power or standing wave ratio from 1:1 to 6:1 with this fine unit. Designed to handle a peak power of well over 1 kilowatt of energy the AM-2 may be left in the antenna system feed line at all times. Band coverage is 160 meters through 2 meters. Input and output impedances for 50 or 75 ohm lines. No external power required for operation. Cabinet size is 7 1/8" x 4 1/8" x 4 1/8". Shpg. Wt. 3 lbs.

ELECTRONIC VOICE CONTROL KIT

This unique device allows you to switch from receiver to transmitter merely by talking into your microphone... you get the advantage of "telephone-type conversation" as in single sideband but with regular AM transmission. The unit is adjustable to all conditions by sensitivity control provided. A variable time delay control changes the "hold" time. Provision is made for receiver and speaker connections and also for a 117 volt antenna relay. Built-in power supply. Complete instructions provided. Shpg. Wt. 5 lbs.

RF POWER METER KIT

This self contained unit requires no power for operation. You simply place it close to the transmitter antenna to sample the RF field which is then indicated on the panel meter. Operates with any transmitter having an output frequency between 100 kc and 250 mc, regardless of power. Sensitivity is 0.3 volts RMS fullscale, and a special control on the panel allows for further adjustment of the sensitivity. Measures 3 1/4" W. x 6 1/4" L. x 2" D. An easy way to put your mind at ease concerning transmitter operation. Shpg. Wt. 2 lbs.

HEATH COMPANY • a subsidiary of Daystrom, Inc. • Benton Harbor 15, Mich.



Choose from a wide variety of Heathkits

DUAL-CHASSIS 20 WATT HI-FI AMPLIFIER KIT



Model W3-AM
(Shpg. Wt. 29 lbs.)

\$49.75

12" UTILITY SPEAKER



Model 401-6
(Shpg. Wt. 7 lbs.)

\$7.50

ALL-BAND RADIO KIT



Model AR-3
(Shpg. Wt. 12 lbs.)

\$29.95

CRYSTAL RADIO KIT



Model CR-1
(Shpg. Wt. 3 lbs.)

\$7.95

BROADCAST BAND RADIO KIT



Model BR-2
(Shpg. Wt. 10 lbs.)

\$18.95

ELECTRONIC CROSSOVER KIT



Model XO-1
(Shpg. Wt. 6 lbs.)

\$18.95

"Q" MULTIPLIER KIT



Model QF-1
(Shpg. Wt. 3 lbs.)

\$9.95

"AUTOMATIC" CONELRAD ALARM KIT



Model CA-1
(Shpg. Wt. 4 lbs.)

\$13.95

GRID DIP METER KIT



Model GD-1B
(Shpg. Wt. 4 lbs.)

\$21.95

VIBRATOR POWER SUPPLY KIT



6 volt Model VP-1-6
12 volt Model VP-1-12
(Shpg. Wt. 4 lbs.)

\$7.95 ea.

VARIABLE FREQUENCY OSCILLATOR KIT



Model VF-1
(Shpg. Wt. 7 lbs.)

\$19.50

PROFESSIONAL RADIATION COUNTER KIT



Model RC-1
(Shpg. Wt. 8 lbs.)

\$79.95

ISOLATION TRANSFORMER KIT



Model IT-1
(Shpg. Wt. 9 lbs.)

\$16.50

ELECTRONIC SWITCH KIT



Model S-3
(Shpg. Wt. 8 lbs.)

\$21.95

REGULATED POWER SUPPLY KIT



Model PS-3
(Shpg. Wt. 17 lbs.)

\$35.50

VOLTAGE CALIBRATOR KIT



Model VC-3
(Shpg. Wt. 4 lbs.)

\$12.50

DIRECT-READING CAPACITY METER KIT



Model CM-1
(Shpg. Wt. 7 lbs.)

\$29.50

TUBE CHECKER KIT



Model TC-2
(Shpg. Wt. 12 lbs.)

\$34.95

EASY TIME PAYMENTS

AVAILABLE FOR YOUR
CONVENIENCE...

Any order totaling \$90 or more can
be paid for in small monthly pay-
ments (send for complete details).

RESISTANCE SUBSTITUTION BOX KIT



Model RS-1
(Shpg. Wt. 2 lbs.)

\$5.50

CONDENSER SUBSTITUTION BOX KIT



Model CS-1
(Shpg. Wt. 2 lbs.)

\$5.50

CATHODE RAY TUBE CHECKER KIT



Model CC-1
(Shpg. Wt. 10 lbs.)

\$24.95

LABORATORY RF GENERATOR KIT



Model LG-1
(Shpg. Wt. 16 lbs.)

\$48.95

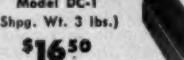
"Q" METER KIT



Model QM-1
(Shpg. Wt. 14 lbs.)

\$44.50

DECADE CAPACITOR KIT



Model DC-1
(Shpg. Wt. 3 lbs.)

\$16.50

DECADE RESISTANCE KIT



Model DR-1
(Shpg. Wt. 4 lbs.)

\$19.50

An important announcement for everyone considering a small-space wide-range speaker system . . . monaural or stereo

ACTUAL TESTS PROVE University RRL*

ULTRA LINEAR RESPONSE SYSTEMS

SUPERIOR

Compared with competitive widely publicized high compliance small space systems

AT \$40 to \$85 SAVING



RRL systems use a specially designed acoustic coupler to load the new University high compliance woofer, enabling it to radiate tremendous bass energy with only small cone excursions. This achieves greater linearity and virtually eliminates distortion. Tweeter response, carefully matched to the woofer's acoustic output, is smooth and flat to beyond 20,000 cps. Result: better bass, cleaner treble, smoother response than any competitive small space, high compliance units based on totally sealed enclosures using "air spring" capacitance loading.

RRL — Radiation Resistance Loading

PROOF OF SUPERIORITY

... as demonstrated by actual comparative measurements* of University Model S-10 RRL ultra linear response system . . . and widely publicized competitive brands X and Y, under identical conditions.

75% LESS BASS DISTORTION

Distortion measured at 30 cycles with equal sound output for all systems.



The highly efficient S-10 requires only $\frac{1}{4}$ of the cone excursion of Brands X and Y to produce the same sound output. Result: greater inherent linearity and 75% less distortion.

Brands X and Y reach overload conditions 4 times sooner (6 db) than the S-10. Bass distortion at higher sound levels is therefore considerably greater with X and Y than with the S-10.

LOWER POWER REQUIREMENTS

Measured average of acoustic energy in 30-100 cps range, demonstrated that Model S-10 performed . . .

4 db better than Brand X
2 db better than Brand Y

This test shows that the S-10 is, in effect, 100% more sensitive. (The ultra linear response systems will fill any average room with sound above normal listening level, using any high quality low power high fidelity amplifier.)

* HOW TESTS WERE CONDUCTED

Frequency response was obtained in an anechoic chamber, using a calibrated Western Electric 640AA Microphone and RA-1095 Amplifier, a General Radio Model 1304B Best Frequency Oscillator and a Sound Apparatus Model FRA Graphic Recorder.

Distortion was measured with a Hewlett-Packard Model 330B Distortion Analyzer. The speakers were driven from a Hewlett-Packard Model 200AB Audio Oscillator, feeding a McIntosh 50-watt Power Amplifier.

WIDER FREQUENCY RESPONSE

Brand X 7 db down at 15,000 cps
Brand Y 2 db down at 15,000 cps
RRL S-10 flat to beyond 20,000 cps

Measured average acoustic energy, 7000-20,000 cps, for equal power inputs, demonstrates that Model S-10 performs . . .

5 db better than Brand X
2 db better than Brand Y

Ultra linear response systems are not handicapped by the treble deficiencies common to competitive systems. With clean program material, the remarkably flat response and exceptionally true reproduction of upper harmonics by the S-10 result in amazingly realistic reproduction without "harshness." A Program Distortion Filter is provided which can be switched into the circuit to correct for inferior radio programs, worn records, tapes, etc.

NO "DAMPING FACTOR" PROBLEMS

Model S-10 RRL will work at maximum effectiveness with any modern (low internal impedance) high fidelity amplifier. No damping factor adjustment at all is needed, whereas both Brands X and Y require optimum settings. If an amplifier does not have this control the performances of Brands X and Y may be adversely affected.

ALL THIS...AND MAJOR COST SAVINGS TOO!

You don't pay a premium for RRL's improved quality and performance. University's superior design and manufacturing know-how has resulted in substantial cost savings to the consumer. Compare for yourself!

Brand X over \$180
Brand Y over \$220
RRL Model S-10 \$159

ALREADY THE ACCEPTED LEADER

At WFUV-FM, pioneering stereo in New York City via FM-Multiplex, RRL systems have been selected for studio monitoring and public demonstrations. Fred Waring chose RRL systems for his latest nationwide high fidelity concert tour. "Research House, 1958" of Beverly Hills, California, awarded its Seal of Research Approval to the RRL systems for their beautiful design as well as quality performance. The undeniable superiority of the RRL ultra linear response speaker systems has been recognized by all authorities who know music and whose work demands the finest in speaker systems.

Hear these magnificent speaker systems at your dealer...soon!

LISSEN

University sounds better



UNIVERSITY LOUDSPEAKERS, INC., 80 SO. KENSICO AVE., WHITE PLAINS, N.Y.

RADIO & TV NEWS



Product Review

AUDIO OSCILLATOR

Dunlap Electronics, Inc. of 764 Ninth St., Des Moines, Iowa has developed two new audio oscillators which will supply audio signals for general testing and measurement in radio, TV, and sound-system applications.

The units furnish audio signals of 1000 and 400 cps at output levels of



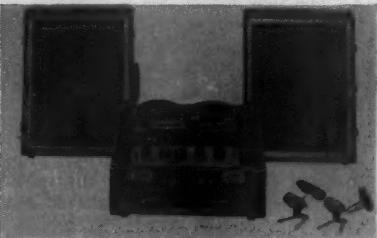
zero db and -60 db at an output impedance of 600 ohms. Model PO-2 has the output available at two phone plugs arranged to fit a standard patch-panel jack. The Model CO-2 terminates in two clip leads for general circuit testing. Switches on top of the units control the output levels and operating frequencies. These self-contained, battery operated units measure 1 1/8" x 2" x 4" and weigh approximately one pound. Printed circuits are used in the construction.

For further details and price information, write the manufacturer.

"STEREORECORDER" 555-A

Superscope, Incorporated, 780 Gower St., Hollywood 38, Calif. has announced the availability of a new model "Stereorecorder," the 555-A.

The unit will record and play back stereo tapes. It will record stereophonically from two microphones or from AM-FM sources. The unit itself contains two built-in preamps and two 4-watt power amplifiers. Tapes speeds



are 7.5 and 3.75 ips. Frequency response is ± 2 db from 50 to 12,000 cps at 7.5 ips and 30 to 10,000 cps at 3.75 ips.

The instrument is equipped with two dynamic microphones and a 4" x 6" monitor speaker. Matching 12" Lansing "Signature" speakers in individual en-

closures are available at additional cost.

This unit is also available with an extra stereo playback head (30 to 12,000 cps) to handle recorded 4-track stereo tapes.

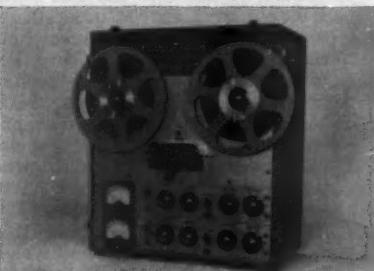
The company will forward a comprehensive data sheet on the Model 555-A upon request.

"CROWN STEREO-X"

International Radio & Electronics Corporation, South 17th St. & Mishawaka Rd., Elkhart, Ind. is currently marketing a new portable stereo tape recorder as the "Crown Stereo-X."

Standard units provide speeds of 15, 7.5, and 3.75 ips with other tape speeds available on request, split or full-track erase, as desired.

Frequency response is 20-30,000 cps ± 2 db at 15 ips; 20-20,000 cps ± 2 db at 7.5 ips; and 20-10,000 cps ± 3 db at 3.75 ips. Flutter and wow is .07% at 15,



.09% at 7.5, and .2% at 3.75 ips speeds. The signal-to-noise ratio is 54 db. All specs determined by NAB standards.

The machine will handle all reel sizes from 5" to the 10 1/2" NAB type with 14" reels accommodated by the long-play model. Fast forward and rewind time is 55 seconds for 2400 feet.

The recorder is of aluminum construction throughout with satin anodized engraved panels.

TAPE CONTAINERS

The Magnetic Shield Division of Perfection Mica Company, Chicago 22, Ill. has recently introduced a line of shielded tape containers designed especially to preserve and protect valuable and irreplaceable recorded tapes.

The containers are available in many sizes and shapes to suit individual requirements. There are round and rectangular cases as well as a new line of round 7 1/2" diameter cases for individual 5" and 7" reels. The containers are made from "Netic" and "Co-Netic" alloys which are non-shock sensitive and non-retentive. They are said to remain effective indefinitely without periodic annealing.

ONLY FROM UNIVERSITY... A
FULL LINE OF RRL ULTRA LINEAR
RESPONSE SYSTEMS AND KITS



Outstanding for monaural—ideal as a stereo pair.

Model S-10 2-WAY SYSTEMS

Components of the S-10 comprise the new 12" C-12HC high compliance, dual voice coil woofer, employed with the UL/HC 2500 cps tweeter and the special matched-level HC-2 crossover network. Also includes the Program Distortion Filter to correct for stridency of inferior radio programs, worn records, tapes, etc. The enclosure is constructed of extra heavy 3/4" furniture hardwoods. Gracefully styled to harmonize with any decor. Model S-10H is for upright use; S-11L, lowboy. Legs on base are removable for shelf, bookcase, or built-in applications. 24" x 14" x 14 1/2" deep. Shpg. wt., 51 lbs. User net: Mahogany-\$139.00, Blond or Walnut-\$143.00.

...and greater efficiency, greater RRL advantages

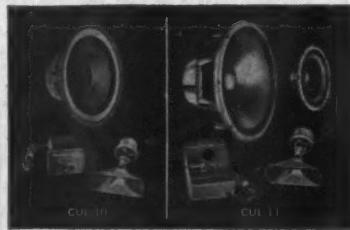
Model S-11 3-WAY SYSTEMS

The S-11 truly stands alone in its field! It cannot be compared with any other existing high compliance system... but only with the most elaborate speaker systems, such as University's famed "Classic." Its handsome compact RRL enclosure houses the new heavy duty high compliance 15" C-15HC dual voice coil woofer. The new HC-3 network provides 500 cps crossover to the 2-way Diffusitone-8 Diffaxial for mid-range and 2500 cps crossover to the special UL/HC Hypersonic Tweeter for response to beyond audibility. The unique Program Distortion Filter and "balance" control complete this magnificent system. Model S-11H is for use as upright; Model S-11L, as lowboy. 26 1/2" x 19 1/2" x 17 1/2" deep. Shpg. wt., 80 lbs. User net: Mahogany-\$245.00, Blond or Walnut-\$249.00.

FOR EVEN GREATER SAVINGS...

Ultra Linear component kits CUL-10, CUL-11

Enjoy the satisfaction of assembling your own superb Ultra Linear Response system along with the added savings thus made possible. Speaker Kit CUL-10 comprises the identical components of Model S-10; speaker kit CUL-11, the components of Model S-11. Both kits are furnished with all wiring cables and complete easy-to-follow instructions for building and installing your own RRL enclosure. User net: CUL-10 - \$88.50, Shpg. wt., 15 lbs. CUL-11 - \$164.50, Shpg. wt., 37 lbs.



UNIVERSITY LOUDSPEAKERS, INC., WHITE PLAINS, N.Y.

DYNAKIT

AMPLIFIER KITS

A great amplifier circuit of superb listening quality in money-saving kit form!



MARK III 60 watts **79⁹⁵**
net

The new Mark III includes all the sensational attributes of the popular Mark II plus these outstanding deluxe features

- ★ 60 watts at less than 1% distortion. Instantaneous peak power of 140 watts. IM less than .05 at average listening levels.
- ★ Choke filtering and low noise circuitry reduce hum and noise to 96 db below 60 watts.
- ★ New rugged KT-88 tubes and other heavy duty parts used conservatively.

MARK III—also available with added 70 volt output.

Mark III-70 **84.95***
net

MARK II 50 watts **69⁷⁵**
net

The Mark II is the best buy in high power high fidelity kits

- ★ Ease of assembly due to uniquely simple circuitry and printed circuit construction with factory-mounted parts.
- ★ Highest stability using patented stabilizing networks with minimum number of phase shifting stages. Suitable for all loudspeaker systems including electrostatic.
- ★ Dyna Biaset (patent pending) for simplified adjustment and complete freedom from effects of unbalanced components. No balancing adjustments required to meet published specifications.
- ★ Dynaco Super-Fidelity output transformer with patented para-coupled windings. This is the finest available transformer of its type for the most critical audio uses.

COMING SOON!
DYNACO
PHONO PICKUP
FOR MONOPHONIC
AND STEREO DISCS

Available from leading Hi-Fi dealers everywhere.
Descriptive brochure available on request.

*Slightly higher in West

DYNACO INC.
Dept. RT, 617 N. 41st St., Phila. 4, Pa.
Export Division: 25 Warren St., New York 7, N.Y.

Recommended for expensive monaural and stereo tapes for the home hi-fi system, these containers were originally developed for defense and industrial applications. Allied Radio in Chicago is handling distribution of these tape containers.

"STEREO-VERTOR"

Components Corporation of Denville, N. J. has announced the availability of a new "Stereo-Vertor" for playing both 45-45 and MSD stereo records.

This unit will demodulate an FM multiplex subcarrier and thus serve three ways for stereo reproduction. It



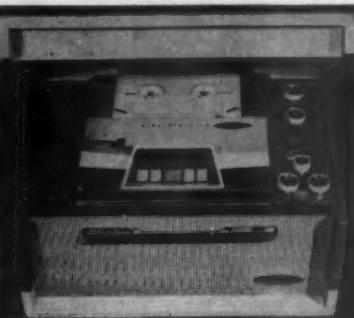
is designed to be used with any existing monaural preamp. The unit will play MSD stereophonic discs by providing the proper filters to separate the carrier from the A + B channel and carrier amplification, limiting, and detection. It converts the FM multiplex output from an FM tuner to two separate channels and recombines them stereophonically into two outputs suitable for use with standard power amplifiers and speakers. It also provides the second preamp channel for use with a 45-45 pickup and provides equalization for use with either a magnetic or ceramic stereophonic pickup.

The "Stereo-Vertor" measures 3½" high, 8" long, and 4" deep and weighs approximately 3 pounds. Full specifications on this unit will be supplied by the manufacturer on request.

TAPE-CARTRIDGE MACHINE

Pentron, Inc., 777 S. Tripp Ave., Chicago, Ill. has recently unveiled its new hi-fi stereo tape-cartridge recorder to the trade.

The two-speed, lightweight machine will play not only the *RCA* 4-track



tape cartridges at 3.75 ips but will play and record at 7.5 ips. At the 3.75 ips speed, music lovers will be able to enjoy a full hour program on a

single cartridge without touching the machine. The unit will also play standard 2-track stereo tapes.

The recorder features five non-jam push-button tape transit controls and a completely functional carrying case. It has a separate preamplifier for each channel and an additional 5-watt power amplifier. Also included are such features as a vu-type meter, automatic shut-off at the end of each cartridge, retractable pressure pads for quick and easy cartridge loading, plus frequency response from 40 to 15,000 cps.

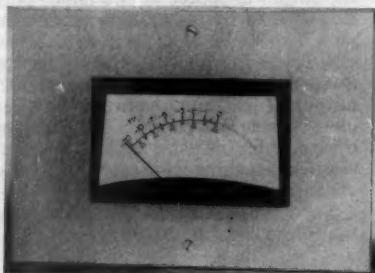
Other features are dual speakers, automatic index counter, fingertip speed-change control, two input jacks, and two output jacks.

The company also announced that all of its open-reel type recorders produced since mid-August are capable of handling both the 3.75 4-track and 7.5 ips 2-track stereo tapes as well as play, record, and erase monaurally.

COMPACT VU METERS

Assembly Products, Inc. of Chesterland, Ohio is now offering a new line of vu meters which meet ASA C16.5-1954 standard but occupy at least 15 percent less panel space than comparable units.

The meters are being supplied in the new Model 561 housing that exposes only the indicating area. The remaining 30 per-cent of the meter is mounted



behind the panel. For easier reading without strain, the dial of the new meter not only has the usual buff background and red numerals, but is tilted back 6 degrees from the horizontal so that glare is reflected upward. To further aid visual comfort, the meter may be illuminated from behind the panel through a strip of translucent plastic across the top of the dial section.

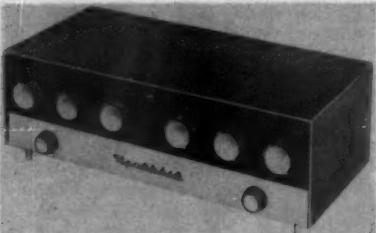
The new meter has a response time for a step change of .3 second, ± 10%. Overshoot is 1 to 1.5%. Calibration follows circuit conditions as defined in the Standard.

MONAURAL-STEREO PREAMP

Heath Company of Benton Harbor, Mich. is now marketing a new preamp which provides all the controls required for either monaural or stereo sound reproduction.

Offered in kit form, the monaural preamp (Model SP-1) is designed to serve as a "building block" in establishing a stereo system. The second channel for stereo can be added at a later date without rewiring. The second channel plug-in for fast conversion or the unit can be built as a stereo

preamplifier from the start (Model SP-2). This latter unit features twelve sepa-



rate inputs, six on each channel with input level controls. Six dual-concentric controls consist of two 8-position selector switches, two bass, two treble, two volume level, and two loudness controls, a scratch filter switch, and a four-position function switch.

The function switch provides settings for stereo, two-channel mix, channel A or channel B for monaural use. Inputs include tape, mike, magnetic phono cartridge, and three high-level inputs. The tape input has NARTB equalization and the input selector provides for RIAA, LP, and 78 rpm record compensation.

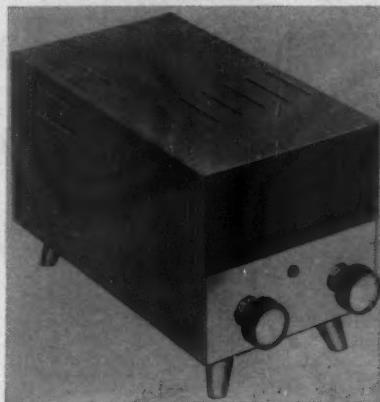
Construction is simplified by the use of two printed circuit boards (one in each channel) and encapsulated printed circuits.

BOGEN STEREO CONVERSION

David Bogen Company, P. O. Box 500, Paramus, N. J. is now offering two low-cost units for converting present hi-fi systems to stereo.

The STA1 stereo adapter and ST10-A adapter-amplifier permit rapid conversion of any Bogen hi-fi unit, irrespective of age. The STA1 permits single-knob control of the volumes of both amplifiers in addition to allowing the user to balance the levels of both channels, invert channels, and select either stereo or monaural sound sources.

The ST10-A is designed to convert an existing monaural hi-fi system into a two-channel stereo system. It incorporates a two-channel preamplifier and a 10-watt amplifier with volume control for both channels simultane-



ously. The unit accommodates a stereo signal from stereo tape or disc. Channel 1 consists of a preamp, 10-watt
(Continued on page 92)

RUINED...
fuzzed up — distorted — trash — your precious record collection swept away because you took chances with an ordinary old fashioned diamond needle. So easy to completely protect your collection with the "Needle That Remembers" — The Duotone Diamond Needle with the safety extra of a memory. Tells you when to check or change your needle. Costs no more. Get details from leading dealers or booklet from Duotone, Kearny, New Jersey.

DUOTONE...
is different

New G-E "Golden Classic" stereo-magnetic cartridge



"GOLDEN CLASSIC"
Model GC-7 (shown above)
with .7 mil diamond stylus
\$23.95*

"GOLDEN CLASSIC"
Model GC-5 (for professional-type tone arms) with
.5 mil diamond stylus
\$26.95*

"STEREO CLASSIC" Model
CL-7 with .7 mil synthetic
sapphire stylus ... \$16.95*
*Manufacturer's suggested resale prices

makes stereo a
practical reality
—at a very
realistic price!

- Compatible with both stereo and monaural records
- Full frequency response, 20 through 20,000 cycles
- "Floating armature" design for increased compliance and reduced record wear. Effective mass of stylus approximately 2 milligrams
- High compliance in all directions—lateral compliance 4×10^{-6} cm/dyne; vertical compliance 2.5×10^{-6} cm/dyne
- Recommended tracking force with professional-type tone arm 2 to 4 grams
- Consistently high separation between channel signals. (Specifications for Model GC-5 with .5 mil diamond stylus.)

GENERAL ELECTRIC

**First
the
fabulous
TD-124**

NOW

**two
new "TD"
Stereo-Monaural
turntables**

Here's good news for budget-minded hi-fi aficionados. These two new Thorens turntables (with integral tone arm) give you the same basic drive mechanism you get in the ultra-precise TD-124 transcription turntable, but they're streamlined for economy. See the new TD-184 and TD-134 at your authorized Thorens hi-fi dealer's today.

TD-134 Manual Player. 4 speeds. It has the same precision-machined, adjustable-speed drive as the Thorens TD-124 transcription turntable for minimum wow, flutter and rumble. Turntable floats on nylon bearings. Integral tone arm equals tracking performance of separate arms costing as much as half the price of this entire unit. Plug in adapter for standard stereo or monaural cartridges. 15" x 12", extends 2½" below panel, 3" above.

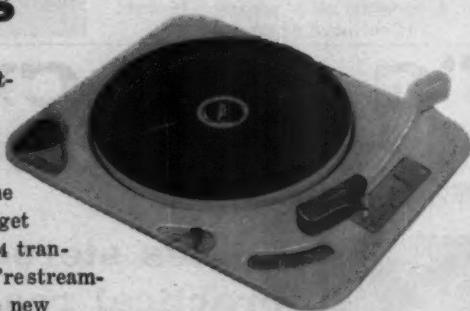
TD-184. Same as TD-134 with semi-automatic operation: One dialing motion selects 7", 10" or 12" record size, starts motor. Arm literally floats down into first record groove on air; adjustable piston controls lowering speed. Absolutely no connection between arm and table during playing. Featherweight position trip shuts off player at end of record, idler disengages and arm lifts. Manual reject control permits shut-off, interruption or manual operation.



TD-124 \$99.75 net



TD-134 \$60.00 net



TD-184 \$75.00 net



Thorens celebrates 75 years of progress in music reproduction

THORENS

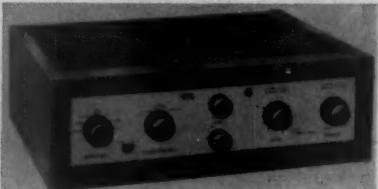
SWISS MADE PRODUCTS
HI-FI COMPONENTS • LIGHTERS
SPRING-POWERED SHAVERS
MUSIC BOXES
NEW HYDE PARK, NEW YORK

power amplifier to drive a speaker, and a tone control while Channel 2 consists of a preamp and cathode-follower to drive the high-level input (such as auxiliary, tape, or tuner) of the amplifier in an existing installation.

STEREO DUAL AMP-PREAMP

Electronic Instrument Co. Inc., 33-00 Northern Blvd., Long Island City 1, N. Y. has added a new stereophonic dual amplifier-preamplifier to its *EICO* line of audio gear available in kit and factory wired form.

The Model HF81 selects, amplifies, and controls any stereo source—tape, discs, broadcasts—and feeds it through



the self-contained dual 14-watt amplifiers to a pair of speaker systems. When the source is monophonic, 28 watts are available to the speaker systems.

The unit provides separate low-level input in each channel for magnetic phono cartridge, tape head, and microphone; separate high-level inputs for AM tuner, FM tuner, FM multiplex, two auxiliary A inputs and two auxiliary B inputs; ganged level controls and separate balance control; independent low-distortion bass and treble controls in each channel; identical Williamson-type push-pull EL84 power amplifiers with quality output transformers; hum balance control, etc.

The amplifier-preamp is housed in a shielded modern enclosure suitable for custom or free-standing installation. It measures 15" wide, 10½" deep, and 4¾" high. Write the manufacturer for full details.

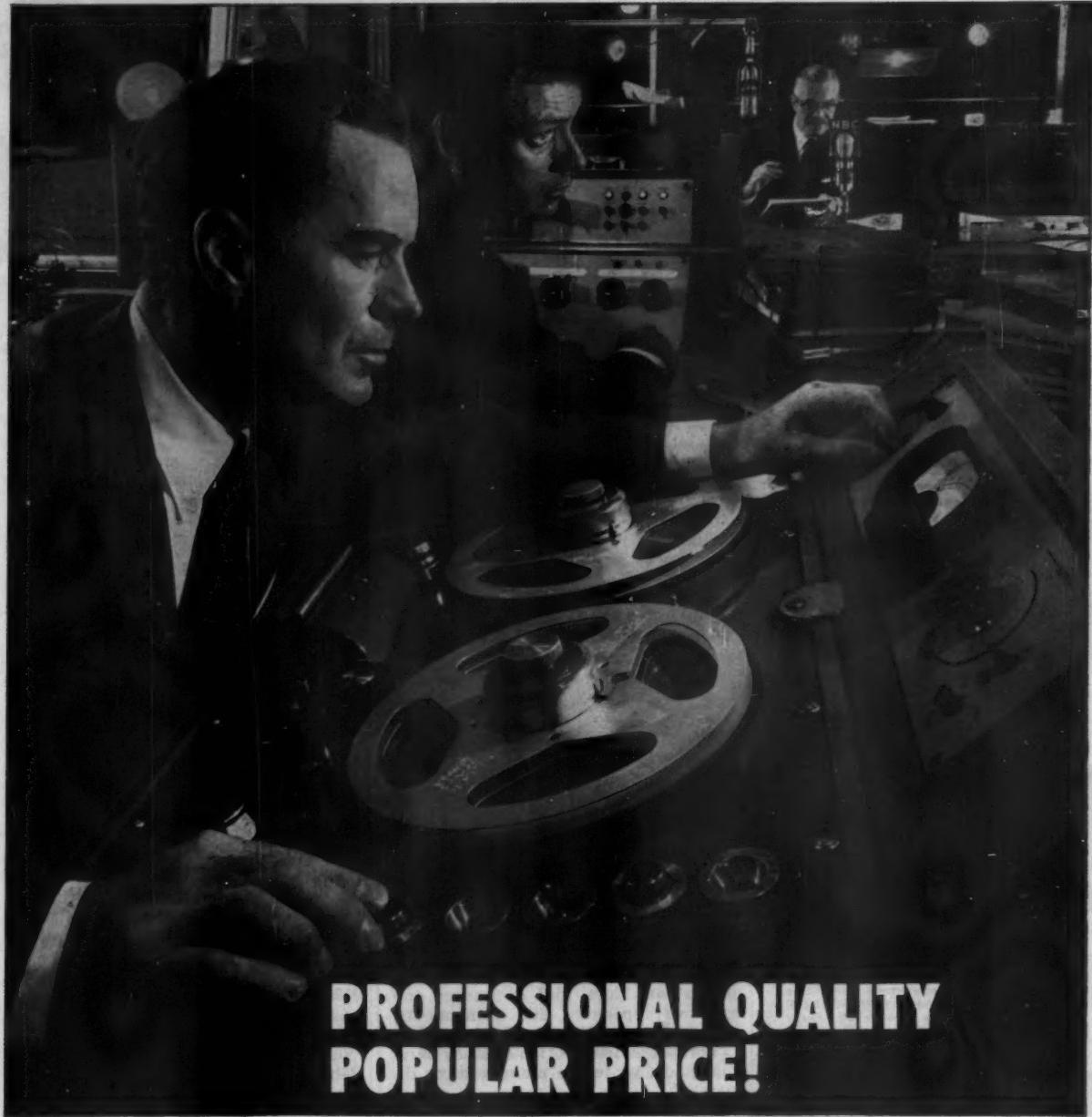
SPEAKER SYSTEMS FOR STEREO

British Industries Corporation, 80 Shore Road, Port Washington, N. Y.

is now offering two Wharfedale "ready-to-play" two-speaker systems which have been especially designed for stereo applications.



The W/AF/1 contains a W10/FSB 10-inch full-range speaker and tweeter with balancing control. The speakers are integrated with a special enclosure (the AF10), incorporating the new patented "Acoustic-Filter" design which improves power-handling capacity at low frequencies and reduces standing-wave effects. The enclosure measures 30" high, 17" wide, and 12" deep and is built entirely of heavy



PROFESSIONAL QUALITY POPULAR PRICE!



Why do network news services rely on "SCOTCH" Magnetic Tape for recording on-the-spot news reports from all over the world? Dependability. Matchless dependability inch after inch, reel after reel. This same professional quality is yours at no extra cost in famous "SCOTCH" Brand Tape for home recording.

"SCOTCH" Brand alone offers you silicone lubrication—a built-in protection for your recorder head—and precision oxide dispersion for controlled uniformity that gives you flawless response.

REG. U.S. PAT. OFF.

SCOTCH Magnetic Tapes

"SCOTCH" IS A REGISTERED TRADEMARK OF 3M CO., ST. PAUL, MINN. EXPORT: 99 PARK AVE., NEW YORK 16. CANADA: LONDON, ONTARIO.

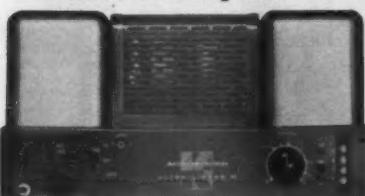
MINNESOTA MINING AND MANUFACTURING COMPANY
... WHERE RESEARCH IS THE KEY TO TOMORROW



**From
any Point of View,
more Experts choose**

ACROSOUND ULTRA-LINEAR II

60 watt amplifier



DESIGN The combination of patented ULTRA-LINEAR circuitry—plus new HYBRID FEEDBACK principle—VARIABLE DAMPING control, and ULTRA STABILITY, represents a new high in the art of amplifier design...an example of ACROSOUND'S latest achievement in AMERICAN Know-How. This superiority of design now enables anyone with or without any previous knowledge of electronics to assemble for himself or herself... (yes! it's that easy!) ...the finest of amplifiers and at a most reasonable cost, in only two hours!



PERFORMANCE By listening test, or by instruments...second to none in clarity and frequency response. Normal level distortion is virtually unmeasurable—IM 1% or less at 60 watts, 120 watts peak. Completely stable... unaffected by loads, perfect square waves.



QUALITY Every part going into the assembly of critical and even non-critical circuitry is tested and checked to allow no more than $\pm 5\%$ variation from ACROSOUND'S standards. Specialized test equipment unavailable commercially was designed in ACROSOUND'S laboratories to achieve this result. Every printed circuit board is placed in trial operation on a laboratory amplifier. Output tubes are matched by trial and double checked.



COMPONENTS ACRO'S newest TO-600 output transformer with special hybrid winding—separates functions of output circuit and feedback circuit. Heavy duty, completely assembled, and thoroughly tested, printed circuit board assures uniformity of performance. Low distortion EL34 output tubes are operated well within their ratings ensuring long tube life and optimum performance.

PRICE In preassembled kit form so that you may save money, learn while doing, and have the proud satisfaction you built the best for only \$79.50 net...or if you feel you would prefer it laboratory assembled it still represents a bargain at \$109.50 net.

HEAR IT AT YOUR DEALER NOW!

BE READY FOR ACROSOUND DISTORTIONLESS PRE AMP DESIGNED FOR THE STEREO PHILE

Experts know why ACRO is best!
Others... Learn why! Write to

ACRO PRODUCTS
369 SHURS LANE
PHILA. 2B. PA.

hardwood. It is available in genuine mahogany, walnut, or blonde. System impedance is 15 ohms.

The W/AF/2 system is similar to the W/AF/1 in outward appearance but is somewhat larger in size (36" high, 23" wide, and 15" deep). It includes the "Super" 12/FS/AL 12-inch full-range speaker and a "Super 3" tweeter with balancing control. It also incorporates the "Acoustic-Filter" design. Finishes and system impedance are the same.

Both enclosures are available separately without the speaker systems. Write Dept. K48 of the company for full details and prices.

AUDIO CATALOGUES

STEREO DISC BOOKLET

The Commercial Service Section of *RCA Service Company*, Camden 8, N. J. has published a new illustrated booklet which explains clearly in readily understandable terms the *RCA Victor* stereophonic recording system.

Entitled "Living Stereo," the booklet explains the principles of stereo, methods of recording, elements of the company's instruments, and details on the 45/45 recording system.

Illustrated with photographs, exploded view diagrams, and schematic drawings, the booklet answers the questions which are being asked by dealers and technicians on this new development.

Copies of the booklet are available at 50 cents each. Orders and payment should be sent direct to the company at the above address.

E-V CATALOGUE

Electro-Voice, Inc. of Buchanan, Michigan, has just issued a comprehensive 16-page catalogue covering its line of audio and communications equipment.

Included in this publication are details on microphones and accessories, communications gear, p.a. projectors, phono cartridges, hi-fi enclosures and speakers, speakers and components, and do-it-yourself enclosure kits.

For a free copy of this handy buying guide, write the manufacturer direct.

LANSING AUDIO LINE

James B. Lansing Sound, Inc., 3249 Casitas Ave., Los Angeles 30, Calif. has issued a new folder, No. SC 504, which carries some forty photographs, drawings, and charts to amplify the technical data on speakers, high- and low-frequency drivers, dividing networks, and various types of enclosures and horns comprising the firm's audio line.

Featured is the "Hartsfield" monaural speaker system and the new "Ranger Paragon" integrated stereophonic reproducer. Beside the various finish styles of the "Paragon," it is also available unfinished for studio, laboratory, or built-in home use.

Copies of the new catalogue are available without charge from the manufacturer.

GREAT!

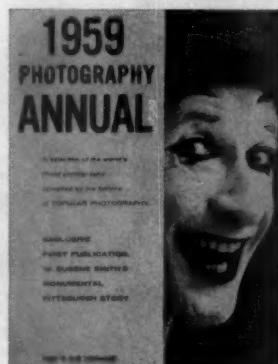


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RADIO & TV NEWS

Simple Stereo Amplifier

(Continued from page 51)

against the side of the cabinet by a 6-32 bolt and nut. The lower ear is wedged into the space between the circuit board and side of the cabinet. Connections must be made to the transformers by flexible wires before the transformers are slipped into their final positions.

Output (voice-coil) connections must be made with the correct polarity to provide negative feedback. Proper connections for *Merit* A-2904 transformers are as follows: Primary: brown, "B+"; red, Grid No. 2; blue, plate. Secondary: No. 1, hot output and feedback; No. 6, ground output. Other makes of transformers may require different connections.

Assembly of the amplifier is completed by attachment of aluminum cover plates to top and bottom. Both covers must have ventilation holes. The amplifier becomes quite hot in operation and if it is to be mounted in a warm or congested location, more holes than shown in the photos should be drilled and, in addition, the sides of the cabinet should be perforated.

The power supply is assembled on a 4" x 6" x 3" chassis, using conventional mounting and wiring procedures. Power requirements of the amplifier are 265 volts d.c. at 100 ma. and 6.3 volts a.c. at 1.2 amps.

Testing and Operation

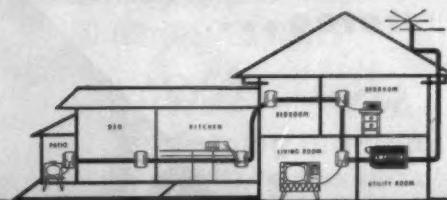
For the first trial under power, R_1 (Fig. 2) should be set to a point near its maximum resistance. The power and line cables are then connected and the line power switch is turned on. After checking to see that all tubes are lighted and no components are seriously overheating, several voltage measurements are made. The "B+" 265-volt terminal should now measure about 200 volts above ground (chassis). If the reading is much lower than this, turn the power off immediately and look for a possible short circuit. A high voltage at this point indicates a possible open or high-resistance circuit.

When everything appears to be normal, R_1 is adjusted until voltage at the "B+ 265 v." terminal reaches that value. Adjustment of this voltage is important in securing minimum distortion at maximum power output. Corresponding correct voltages at various tube pins in Fig. 1 are as follows (all positive with respect to chassis): V_1 : Pins 1 and 6, 130 v.; Pins 2 and 7, 1.5 v. V_2 and V_3 : Pins 1 and 8, 255 v.; Pin 9, 245 v.; Pin 7, 14 v.

The amplifier is now complete and ready for a final listening test. The pickup cartridge is connected by two shielded lines terminating in pin plugs. The speaker circuits have a common, grounded terminal, thus a 3-wire cable may be used between the amplifier and the speakers. -30-

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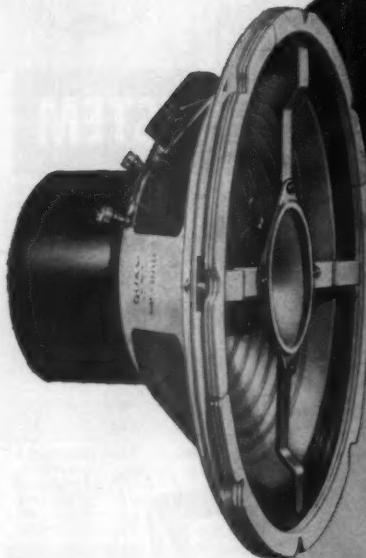
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Key Test Points in TV
(Continued from page 63)

r.f. tubes such as the 6BQ7 are often driven harder than they should be.

Thus, while a glance in the tube manual would lead you to expect 11 ma. or so of plate current (11-volt drop across 1000 ohms), you will often normally find 20 ma., and sometimes considerably more, if there is a weak or no-signal condition and the a.g.c. is producing zero bias on the tuner bias line. A check across the r.f. decoupling resistor when tuning to different channels is most revealing. The current flow may vary from 23 ma. on a very weak signal to less than 1 ma. on a really strong one—a good explanation for the fact that some cascode tubes apparently go on forever, while others have to be replaced every few months.

Total "B+" Drain

Almost every set uses a choke for "B+" filtering and the voltage drop across this component can be used as an indication of the total current drain of the receiver. However, if the check is being made to find out why the rectifier tube keeps failing more quickly than is normal after replacement, be careful. Don't overlook the fact that the current through the filter choke does not include the current through the input filter capacitor. Excessive leakage through this capacitor will damage the rectifier, but this leakage current will be bypassed to ground without ever having passed through the choke.

—30—

Soldier inspects message from new super-speed teletypewriter developed for U.S. Army by Kleinschmidt Laboratories. By far the fastest machine of its kind, it stamps out messages at 750 words a minute—ten times faster than standard equipment. Tape spews from the device at more than seven inches a second. Mounted on a radio-equipped jeep, the new message printer and code puncher is tested as part of a unified mobile communications center, of which the radio van that is seen in the left background is a part.



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FM specifications include grounded-grid triode low noise front end with triode mixer, double-tuned dual limiters with Foster-Seeley discriminator, less than 1% harmonic distortion, frequency response 20-20,000 cps $\pm \frac{1}{2}$ db, full 200 kc bandwidth and sensitivity of 2 microvolts for 30 db quieting with full limiting on one microvolt. AM specifications include 3 stages of AVC, 10 kc whistle filter,

built-in ferrite loop antenna, less than 1% harmonic distortion, sensitivity of 5 microvolts, 8-ke bandwidth and frequency response 20-5000 cps ± 3 db. The 5 controls of the KT-500 are FM Volume, AM Volume, FM Tuning, AM Tuning and 5-position Function Selector Switch. Tastefully styled with gold-brass escutcheons having dark maroon background plus matching maroon knobs with gold inserts. The Lafayette Stereo Tuner was designed with the builder in mind. Two separate printed circuit boards make construction and wiring simple, even for such a complex unit. Complete kit includes all parts and metal cover, step-by-step instruction manual, schematic and pictorial diagrams. Size is 13 $\frac{3}{4}$ " W x 10 $\frac{1}{2}$ " D x 4 $\frac{1}{2}$ " H. Shpg. wt., .22 lbs.

The new Lafayette Model KT-500 Stereo FM-AM Tuner is a companion piece to the Models KT-300 Audio Control Center Kit and KT-400 70-watt Basic Amplifier Kit and the "Triumvirate" of these 3 units form the heart of a top quality stereo hi-fi system.

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"F.M. RADIO SERVICING HANDBOOK" by Gordon J. King. Published by *The Macmillan Company*, New York. 188 pages. Price \$5.00.

The tremendous popularity of the hi-fi concept and the enthusiasm with which audiophiles are embracing stereo reproduction has pumped new blood into FM—long a "patient" threatened with pernicious anemia.

As a result of this remarkable "recovery," thousands of FM receivers and tuners are moving into the hands of customers each month. In the normal scheme of things, this means that more and more of such equipment items will be showing up in the service shops across the country.

Although this is a specialized text, written by a British engineer about British equipment and allocations, most of the information is equally applicable to the FM receivers and tuners available in the U. S.

There are 11 chapters in this book covering the FM signal, the advantages of FM, FM detectors, r.f. and frequency converter stages, i.f. stages, FM-AM receivers, FM adapters, v.h.f. and FM antennas, FM receiver alignment, servicing FM receivers, and the audio sections and high-fidelity performance. The terminology is British and the test equipment and FM receivers discussed are of British manufacture but the subject matter is basic enough to be of major assistance to the technician on this side of the Atlantic who is finding more and more of these receivers/tuners on his shop bench.

* * *

"REPAIRING PORTABLE AND CLOCK RADIOS" by Ben Crissens & David Gnessin. Published by *John F. Rider Publisher, Inc.*, New York. 117 pages. Price \$2.75. Soft cover.

Since small portable radios show up in the Christmas stockings of even the youngest of the small fry, there are literally millions of these sets around. The very nature of their use makes it dead certain that many of these will require servicing in the course of a year. Rough handling, exposure to inclement weather, and normal attrition are virtual guarantees of this service market. For the technician who wants a steady and lucrative business, small radio repairs offer certain advantages.

This handy manual covers the power supplies used in portables and clock radios, switching circuits in a.c.-d.c. portables, transistorized units and the special problems involved, mechanical troubles, troubleshooting, repair and replacement of parts, circuit modifications, etc.

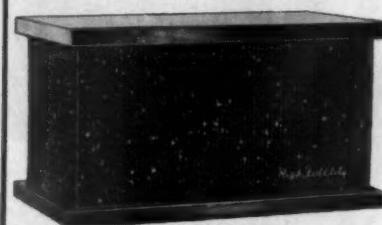
The discussion of clock radios in-

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Cabinet: all hardwoods, in Walnut, Mahogany, Blonde, or Ebony finishes;
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MODEL NO. MS-555

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cludes clock mechanisms, and their electrical connections as well as the purely radio circuitry. The alarm and switch adjustments are covered in careful detail.

Technicians who have avoided this type of service work in the past will find it worthwhile to brush up on the time- and temper-savers covered by the authors and then go after this income with confidence.

"ELECTRONIC PUZZLES AND GAMES" by Matthew Mandl. Published by *Gernsback Library, Inc.*, New York. 124 pages. Price \$1.95. Soft cover.

Who can resist the lure of a clever puzzle or a challenging game? The publishers of this little book believe such an appeal is practically universal and not limited to specific age groups or electronic experience levels.

This volume covers the construction of 20 different games—ranging in complexity from a simple knife-switch puzzle to space-travel and horse races. Each basic type of game is fully illustrated. Detailed diagrams and "how-to" instructions make even the most diffident constructor a veritable "maestro of the soldering iron."

The circuits are designed to require a minimum of "props"—a soldering iron, tin snips, a few basic woodworking tools, wire, batteries, and flashlight bulbs should see the builder through.

"HIGH QUALITY SOUND REPRODUCTION" by James Moir. Published by *The Macmillan Co.*, New York. 591 pages. Price \$14.00.

It is a Herculean task to attempt to cover the entire field of sound reproduction in a single volume with any degree of completeness. Mr. Moir, however, has succeeded admirably in cramming a very large amount of useful information between the covers of this book. Words have not been wasted in presenting a good many "facts of life" in hi-fi reproduction. The author, who is with the British firm, *Thomson-Houston Co.*, has drawn heavily on his 20 years of experience in developing high-quality sound systems but has not lost the enthusiasm of a tyro.

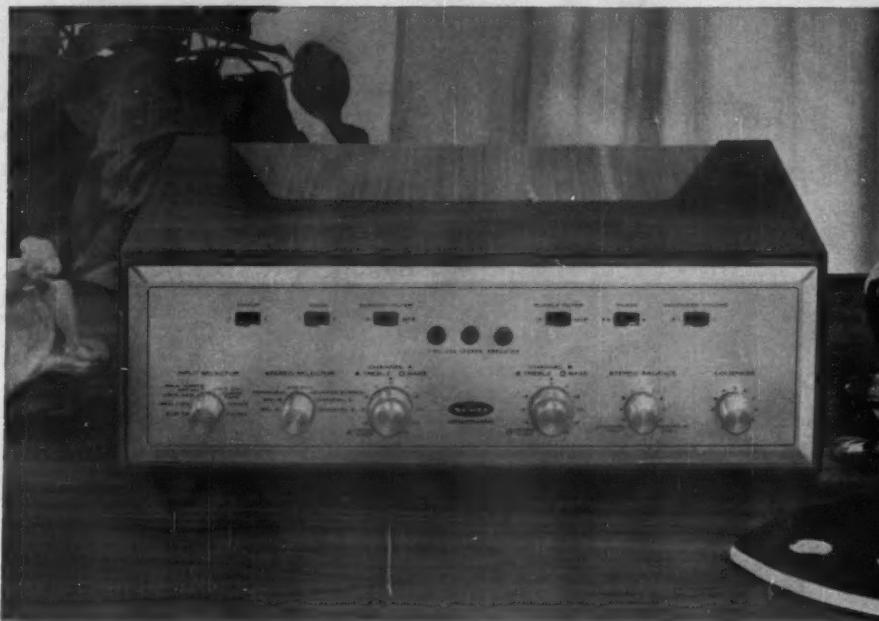
This comprehensive volume is slanted both for the professional engineer and for the knowledgeable amateur with a serious interest in audio. Specific design information and mathematical treatment, when used, are concentrated in appendices at the ends of the various chapters so as not to interrupt less technical readers. Although much of the equipment shown and the standards used are British, U. S. readers will find a lot to interest them. In addition to coverage of most of the electronics and transducers that go into a hi-fi system, interesting chapters on the objective characteristics of sound, performance of the hearing system, and realistic performance specs are included.

Recommendations for further reading are given along with a useful glossary of terms.

—50—

October, 1958

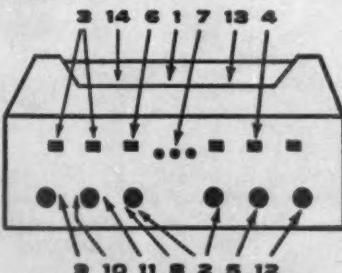
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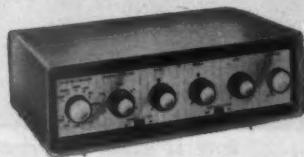
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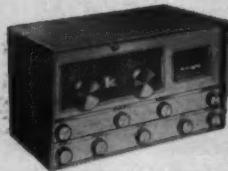
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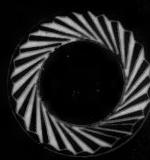
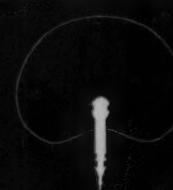
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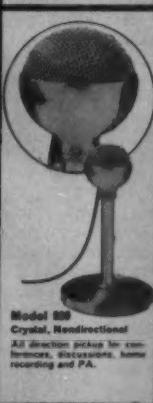
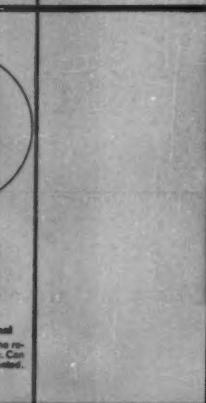
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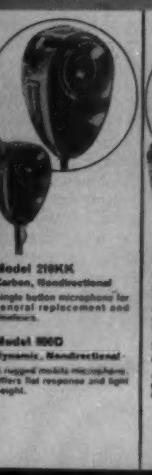
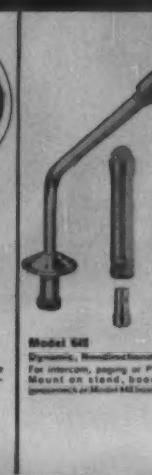
							
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IT TAKES TWO TO STEREO by Walter O. Stanton.

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RECORD REVIEW

By BERT WHYTE

A FEW weeks ago, I crammed into the exhibits at the National Association of Music Merchants show in Chicago and came face to face with the first commercial stereo disc releases. As expected, the stereo discs were the prime focus of the show and literally every component or radio-phonograph manufacturer built his exhibit around this theme. I visited the exhibits of such well-known hi-fi people as *Bosak* and *Ampex*, as well as many of the big commercial people like *Admiral*, *Philco*, *Motorola*, etc. One thing struck me immediately—and this was the almost unqualified acceptance of the stereo disc as a sort of merchandising panacea and the new Pied Piper that can lead the industry into another boom.

This, in itself, was encouraging but, at least to these ears, also somewhat puzzling and surprising. I say this because I must in all honesty report to you that the quality of sound produced by many of the stereo discs left a great deal to be desired. Let me go a step further and state that some of the worst sound I have ever heard was put forth at this show and yet most of the exhibitors beamed happily as if we were hearing the very finest quality possible.

This business of quality is two-sided. On the one hand, many of the radio-phonographs that were displayed and were specifically built for the stereo disc exhibited many characteristics which we would never tolerate in ordinary monaural reproduction. By this I mean excessive rumble and boombiness, high levels of distortion, and excessive levels of hum and noise. Nominally stereo is supposed to be listened to through two speakers placed a certain distance apart, this distance largely dependent upon the size of the room involved. However small a room might be, it is literally impossible to achieve any sort of genuine stereophonic perception with the speakers placed less than four feet apart. Many of the units exhibited had a speaker placement far less than this and thus much of the directional effect of stereo was either greatly reduced or almost totally absent.

In the case of the stereo records involved, it is rather unfortunate to have to report that, if anything, more fault lies here than in the machines used to reproduce them. What is wrong with stereo records? I am afraid this could cover the whole gamut of what can be wrong with a disc. The most noticeable defect on the stereo offerings of many manufacturers is the very low level at which they were cut. Evidently the mysteries of the *Westrex* stereo cutter have been solved by very few people and it was not unusual to find many discs which were as much as twelve to fourteen db below the level of a standard monaural disc. You can appreciate the difficulties this generated for the manufacturers of the cheaper commercial stereo phonographs. These units, for the most part,

rarely have more than 5 to 8 watts of power and utilize comparatively inefficient speakers, thus when called upon to make up for a deficiency of 12 to 14 db on some of these discs, the poor little things could hardly make any room-filling level possible, or if this were achieved, it was naturally with very heavy concomitant hum and noise levels, since they were being played at the top of their gain-settings.

As if low levels of sound were not bad enough on many of the stereo discs, there were other problems which, while noticeable and annoying in monaural reproduction, became gross exaggerations with the stereo disc. Such things as "spindle-hole" eccentricities which normally cause "wow" would, in the case of stereo, also cause a cyclic "swish-swash" type of sound and even comparatively modest degrees of warpage in the record would cause another type of cyclic and annoying noise modulation. This, of course, is a problem that can be traced to the vertical and lateral components of sound which exist in each groove of a "45-45" stereo record and since the stereo pickup is necessarily built to be more sensitive from a compliance viewpoint than a monaural unit, any aberrations at all are bound to cause trouble. Perhaps by now some of my regular readers are wondering about the nature of this report thus far, since it is far from laudatory and, as old-time readers, they know I have always been an avid booster of everything stereo. Well, facts are facts, and I would be doing you a disservice if I were to report on stereo discs without complete honesty and candor.

Despite the disappointments that I encountered at the NAMM show, there is a brighter side to the picture. There are, indeed, some good stereo discs that fulfill all the promise they seem to hold and which give every indication of realizing the great potential of stereo disc. When I say there were some good discs, unfortunately this does not include the products of every manufacturer. Some were a total loss as far as I am concerned, in terms of stereo, but occasionally from some of the bigger manufacturers and a few of the independents was heard a reasonably good stereo disc.

However, for absolute top-quality stereo on a fairly consistent level, the plum must go to *London Records*. I hope my many friends in the record business will forgive me for choosing *London* and excluding them, but under the conditions which I heard all brands at the show and under the much more carefully controlled conditions under which I heard the same discs at home, I could scarcely and honestly come to any other conclusion. The *London* discs had all the stereo vir-

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publishers of this magazine.

tues such as good directionality, excellent sense of depth perspective, the records were cut at levels approaching *London's* normal monaural output, and the surfaces were pleasingly quiet. In all cases the sound was as brilliant and clean as we have come to expect from the *London* monaural product. Now, you will note that I pointed out that *London* stereo records were the most consistently good, which would indicate that even here there is occasionally trouble of the type previously described.

This is not an entirely cheerful picture, I will admit, but I think I can safely say that the quality of stereo discs from most of the other manufacturers should improve rapidly, as they learn how to master the *Westrex* cutter. After all, *London* records did have a head start with its early experiments with other types of stereo discs which obviously has given them an edge in the present stereo processes. Surely with the technical facilities that can be brought to bear by many of our companies, these faults will soon be rectified.

It is obvious from the foregoing that some prudence is indicated in the selection of stereo disc material if you are now set up to play these discs and you are especially advised with stereo discs of any manufacturer to avoid off-center and warped records. The following stereo records have been chosen with an eye towards giving you what I consider the best on the current market.

STRAVINSKY PETROUCHKA

L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London CS-6009. Price \$4.98.

This is the new "Petrouchka" which I reviewed monaurally just recently and, as I pointed out then, it certainly qualified as one

of the very best "Petrouchkas" in existence as well as a near definitive performance. Here in this stereo version all of its virtues are greatly enhanced. This is probably the very best of the current crop of stereo disc releases. It has excellent directivity, yet not at the expense of the well-known "hole-in-the-middle." *London* evidently knows how to record stereo so as to afford us an unbroken sonic front. The depth perspective here was excellent and evidently it was carefully calculated and tailored to the reverberation characteristics of the hall in which it was recorded.

The disc is almost indistinguishable from the monaural product in sound level, is clean and distortionless throughout the audio range, and preserves the dynamic range very well. In the above explanation I gave on some of the failings of stereo discs, I neglected to mention the problem of bass response. It seemed that if some records did have high sound level, it was at the expense of a greatly diminished bass. Or, if they had a reasonable bass response, it was at the expense of diminished level. Those records which combined good bass and high sound levels were the exception and this is one of the primary advantages of *London's* stereo discs.

On this present disc, bass response is fully realized and there are some magnificent bass drum and tympani passages which come through with great impact and articulation. To anticipate the inevitable question . . . is this as good as some of the better stereo tapes, the answer is "yes and no." "No" from the fact that it cannot quite match the expansive dynamics nor the degree of instrumental separation afforded by the best tapes and from the "yes" viewpoint, it is every bit as brilliant as many tapes and, excepting an occasional and inevitable "tick" or "pop"

(Continued on page 108)

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from the record, has a better signal-to-noise ratio.

It is too early, of course, to state what the wear qualities of the stereo disc will be, in comparison to the almost wear-less tapes, however, I have played this particular disc for a good many people as a demonstration of what can be expected from a good stereo disc in terms of sound quality, and in the course of this, must have played it at least thirty times, with very little diminution of quality being audibly evident. If you have a stereo disc rig and have thus far been disappointed with it because of the material you have had to play on it, I assure you that this splendid "Petrouchka" will allay your fears and give you a hint of the wonderful things to come.

DEBUSSY

PRELUDE TO THE AFTERNOON OF A FAUN

LA MER

RAVEL

Rhapsody Espagnole

L'Orchestre de la Suisse Romande conducted by Ernest Ansermet. London CS-6024. Price \$4.98.

Here is another of the outstanding London stereo discs, this one a tasty potpourri by Ernest Ansermet which shows off these three standards to glittering advantage. I understand London has embarked on a program of re-recording many of the works made famous in sound quality and in interpretations by their various conductors in the monaural versions. This disc is of that type and I must say they have done a magnificent job of recording.

Ansermet's interpretation of these works is too well-known to require much comment, suffice it to say that he is up to his usual high standard in this highly atmospheric music and except for perhaps a general quickening of his tempi, seems every bit as good as his previous efforts with these works.

Sound-wise, the most extraordinary piece here is the "Rhapsody Espagnole," in which its violent dynamic contrasts are fully captured along with the very wonderful interplay among the various string choirs. Here again we have notable percussion of both the high and low variety. The inter-channel separation of the stereo cutter is supposed to be on the order of 30 db. I have been using for these reviews a Pickering stereo "Fluxvalve" cartridge for which an inter-channel separation of close to 25 db is claimed. So this is a fairly close correlation and any deficiencies of channel separation would be most apparent from the disc. With this and the other London discs, this disparity was not noted, there being here, as in the others, excellent separation and directionality.

Even at this early stage of stereo discs, I do not think it would be imprudent to invest in this London disc and some of the others, as they are quite excellent in nearly all respects and further improvement here would be rather marginal.

GERSHWIN

AN AMERICAN IN PARIS RHAPSODY IN BLUE

Reid Nibley, pianist, with Utah Symphony Orchestra conducted by Maurice Abravanel. Westminster WST-14002. Price \$4.98.

Westminster has had over the course of the past years a very considerable reputation for the excellent quality of its sound. Many of the monaural discs produced by this company have been outstanding and have found wide use in demonstration salons. I have always had a high regard for its products in general and thus it is with no little regret that I report its first stereo discs do not carry on this tradition of quality. This is a

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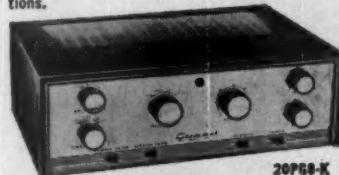
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The "Rondes de Printemps" and the "Gigues" are somewhat less athletic works than the "Iberia," but fare equally well in Argenta's hands and also afford many exciting examples of fine stereo disc sound. Again, let me say that it is this type of stereo disc that should convince any "doubting Thomases" who feel that stereo disc is nothing but a "gimmick."

BEETHOVEN

SYMPHONY NO. 5

Philharmonic Promenade Orchestra of London conducted by Sir Adrian Boult. Vanguard VSD-2003. Price \$4.98.

This is the other side of the *Vanguard* stereo coin and, unhappily, not a very bright one. Sir Adrian and his orchestra give a vigorous and spirited performance of this work, as has been noted previously in my column and elsewhere. However, as regards the stereo disc sound quality, it leaves much to be desired, not that it is distorted or not clean in most sections, but that it is recorded at such a very low level that it makes it very difficult to play without noise on any but the very top quality stereo systems. A pity, because from other stereo viewpoints, it is more than acceptable and would have been a welcome addition to almost anyone's stereo disc library.

This is all the space I can devote to stereo discs this month. Next month I will bring you a comparison and evaluation of the two Berlioz "Requiem" that have appeared on stereo disc, as well as reporting to you on other examples of stereo discs in the classical vein and also bring you my impressions of some of the pop and jazz material that has appeared.

-50-

New experimental Army earphones can turn an ear-splitting roar to a whisper electronically. The tiny circular microphone (lower disc) in the earpiece picks up noise that leaks through ear cushioning. It then produces a second noise, opposite in phase to the first, which in great measure cancels the first to produce relative quiet. Radio messages, however, come through loud and clear. The system was developed jointly by RCA and the U. S. Army Signal Research and Development Lab.



Approach to Hi-Fi Service

(Continued from page 59)

formance cannot be achieved without a number of instruments, many of them specialized, but this is not as much of a deterrent as it is often believed to be. One reason is that the majority of complaints, as in other types of electronic equipment, can be handled with routine techniques and a minimum of specialized equipment. Another factor is the fact that the full complement of desired equipment can be accumulated gradually and that this may be done nowadays at much less cost than was once the case. Of help in this direction is the fact that much of the equipment is already in the shop and that ingenious substitutions can be made, as will be noted, for some very expensive units.

A comprehensive list of required and recommended gear appears in Table 2. Items marked with asterisks are the basic ones that should be on hand rather early in the game. With respect to these, there should not be much of a problem.

Some of the other items on the list are far less formidable than they sound, with respect to type and price. A more-or-less standardized hi-fi rig, for comparison and possible substitution testing is, of course, important. As for distortion analyzers and a.f. voltmeters and/or wattmeters, many relatively inexpensive units are now available, in

kit or wired form. Now becoming popular are combination instruments that may incorporate such functions as that of the signal generator, the distortion analyzer, and meters. These versatile audio analyzers often avoid the duplication that is involved in buying separate instruments.

Such devices as wow-and-flutter meters, audio-sweep generators, and calibrated microphones can be very expensive indeed. However, the requirements of a service shop are not those of an audio design and research laboratory. Test records and test tapes are available, for example, which can be used to give fairly good relative indications of wow and flutter. While it may not be possible to render the results in exact figures, the technician can use such recordings to determine whether the audiophile customer is or is not satisfied with the wow and flutter characteristics of his gear.

In lieu of an audio-frequency sweep generator, test discs are available on which audio-sweep signals have been recorded. A test microphone is not necessarily an absolutely perfect instrument selling for several hundred dollars. Some manufacturers who make very good microphones at reasonable prices offer a calibration service for a few dollars extra. Once a good microphone has been so calibrated and its deviations from ideal performance are known and recorded, these variations may be taken into account quite easily in conducting tests.

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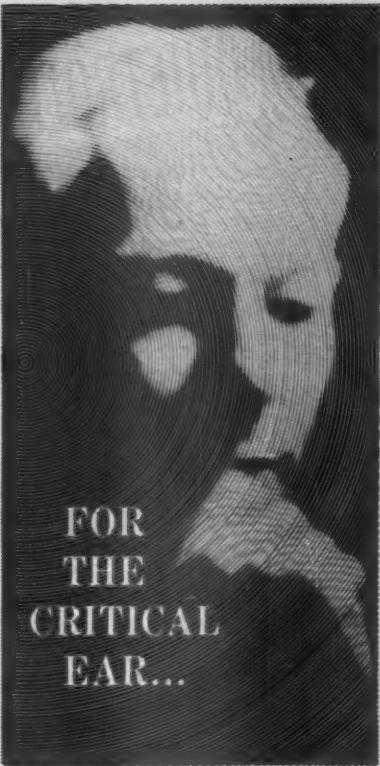
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Literature available: Department 13-J.

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Stereo Disc Recording

(Continued from page 67)

Demonstrated"). Briefly stated, the MSD system utilizes carrier multiplex above the audible spectrum to record the "difference" information which results when the two stereo channels are subtracted vectorially. The vector sum is recorded normally and simultaneously with the FM carrier. Of course, the resulting groove resembles a normal lateral recording except that there is a superimposed 25 kc. carrier of moderate level (4 cm./sec. velocity).

Since the vector sum of two stereo channels is the normal monaural "mix"—the audible lateral groove modulation of the MSD system is fully compatible with existing monaural records.

The MSD can be played monaurally with any LP pickup in good working order without damage. It can be played stereophonically with wide-range monaural pickups with the aid of an auxiliary converter which will be described later.

Playing time of an MSD record is about the same as a standard LP. If extended playing time is necessary, the use of auto margin and a smaller tip radius, such as 0.7 mil, will permit substantially the same playing time as a regular LP record. The reason for this is that the carrier groove modulation amplitude is only 20 millionths of an inch, so no appreciable increase in over-all groove excursion is necessary over that required for a standard LP.

The vertical rumble is no problem with the MSD system since the pickup need not respond to vertical motion.

The commercial converter unit designed for MSD provides a 25 kc. carrier filter, amplifier, limiter, and detector which can also be used to de-

modulate a broadcast FM multiplex signal.¹

Columbia System

The recently announced Columbia system as described by Dr. Goldmark ("New Compatible Stereo Disc," June, 1958 issue) records the vector sum of the right and left channels laterally but the vector difference is recorded vertically in the same groove simultaneously with the same cutter. Such a disc would be similar to a 45-45 except that Dr. Goldmark proposed the limitation of the amplitude of the vertical groove modulation to less than one-tenth that of a 45-45 disc by an undisclosed method. This limitation in vertical amplitude can be done with a limiter or a high-pass filter in the "difference" channel before recording.

The advantage claimed for the Columbia system is that it is compatible with standard LP records because of reduced vertical groove modulation.

Since few demonstrations have been made and no records have been placed on sale by Columbia, complete evaluation of this modification of the 45-45 system cannot be made at this time.

It should be noted, however, that the Fairchild Recording Equipment Company has suggested the use of its program compressor in the vertical channel of its vertical-lateral cutting system for better results when cutting 45-45 masters. The Fairchild cutter is not yet available to the industry.

Comparison

No comparison has been made of relative frequency response, harmonic distortion, and signal-to-noise ratios of the various systems described. In the present state of the art these three factors are subject to variation as a result of limitations on the test equipment and a lack of established test methods.

-30-

¹ This unit, available from Components Corp., is known as the "Stereo-Vertor."

VARIED PROGRAM AVAILABLE ON STEREO DISCS

As we go to press, virtually every record firm is represented on the market by a varied selection of stereo discs. Available now in record shops across the country are selections ranging from pop to classical. In addition to the "big name" labels, a host of new firms are bidding for a share of the stereo dollar by offering unusual or unique program material. Prices of these new discs range from a modest 98 cents for an "Extended Play" recording to \$11.98 for some of the more elaborate two-disc albums. Among the "good buys" for beginning "stereophiles" are the various demonstration and test discs being offered at reduced prices as a special inducement to try out this new medium. The following is a list of such test and "demo" recordings, along with catalogue number and price. Except where noted, these discs are available at record shops.

LABEL	NAME	NUMBER	PRICE
Audio-Fidelity	"Stereo Phonic Demonstration & Sound Effects Record"	AFSD-5890	\$6.95
Components Corp. (Denville, N. J.)	"33 1/3 Stereo Test Record" (checks 45-45 cartridge balance, channel separation, and rumble)	58-45/45	\$1.00
Concert-Disc	"Sound in the Round"	CS-22	\$6.95
Electro-Voice	"Stereo Demonstration Record"	SMP-4X	\$1.50
Elektra	"Around the World in Stereo"	HLP-310	\$3.98
Hallmark	"Full-Dimensional Stereo Demonstration Record"	PS-100	\$4.98
London	"Journey Into Stereo Sound"	(7")	\$.50
Omega Disc	"Stereo L-P Preview"	SRV-103-SO	\$2.95
Vanguard	"Scheherazade"	VST-1	\$2.95
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77 VACUUM TUBE VOLTMETER

WITH NEW 6" FULL-VIEW METER



Traditionally, the V.T.V.M. has been the one instrument used for voltage measurements where low-drain or wide frequency response is essential. And now, the Model 77 V.T.V.M. by taking advantage of new developments including modern balanced push-pull circuit design, etched circuitry, an extra large meter and other improvements provides such measurements quicker, with a higher degree of accuracy and with better readability.

The Model 77 will measure DC with negligible loading and AC of ANY WAVE FORM; whether sine wave, pulse wave, spike wave, square wave or other complex wave forms. It will measure all AC from 30 cycles to over 5 megacycles and will do so without additional accessories or cables.

AS A DC VOLTMETER: The Model 77 will measure any voltage up to 1500 volts with negligible loading. It is indispensable in receiver and Hi-Fi Amplifier servicing and a must for Black and White and color TV servicing where circuit loading cannot be tolerated. A special feature permits accurate zero center measurements necessary for the true alignment of Foster-Seely (Armstrong) FM detectors, Ratio Detectors and the newer Gated Beam Detectors.

AS AN AC VOLTMETER: The old-fashioned laboratory AC V.T.V.M. was cumbersome, erratic, and required several dial manipulations to arrive at a reading. The Model 77 when connected to a circuit will quickly and simply measure its RMS value if sine wave, and its peak-to-peak value if complex wave. Pedestal voltages that determine the "black" level in TV receivers, sync pulses and saw tooth voltages are easily read with the Model 77.

Compare it to any peak-to-peak V.T.V.M.
made by any other manufacturer at any price!

- ✓ Model 77 completely wired and calibrated with accessories (including probe, test leads and portable carrying case) sells for only \$42.50.
- ✓ Model 77 employs a sensitive six inch meter. Extra large meter scale enables us to print all calibrations in large easy-to-read type.
- ✓ Model 77 uses new improved SICO printed circuitry.
- ✓ Model 77 employs a 12AU7 as D.C. amplifier and two 9006's as peak-to-peak voltage rectifiers to assure maximum stability.
- ✓ Model 77 uses a selenium-rectified power supply resulting in less heat and thus reducing possibility of damage or value changes of delicate components.
- ✓ Model 77 meter is virtually burn-out proof. The sensitive 400 microampere meter is isolated from the measuring circuit by a balanced push-pull amplifier.
- ✓ Model 77 uses selected 1% zero temperature coefficient resistors as multipliers. This assures unchanging accurate readings on all ranges.

S P E C I F I C A T I O N S

- DC VOLTS — 0 to 3/15/75/150/300/750/1500 volts at 11 megohms input resistance.
- AC VOLTS (RMS) — 0 to 3/15/75/150/300/750/1500 volts.
- AC VOLTS (Peak to Peak) — 0 to 8/40/200/400/800/2000 volts.
- ELECTRONIC OHMMETER — 0 to 1000 ohms/10,000 ohms/100,000 ohms/1 megohm/10 megohms/100 megohms/1,000 megohms.
- DECIBELS — -10 db to +18 db, +10 db to +38 db, +30 db to +35 db. All based on 0 db = .006 watts (6 mw) into a 300 ohm line (1.73v).
- ZERO CENTER METER — For discriminator alignment with full scale range of 0 to 1.5/7.5/37.5/75/150/375/750 volts at 11 megohms input resistance.

AS AN ELECTRONIC OHMMETER: Because of its wide coverage of measurement in the resistance range (from .2 ohms to 1,000 megohms) the Model 77 will be your most frequently used resistance meter. Leaky capacitors which may not show up on other resistance meters, show up glaringly when tested with the new Model 77. Because of its sensitivity and low loading, intermittents are more easily found, isolated and repaired.

Model 77 comes complete with operating instructions, probe and test leads. Use it on the bench — use it on calls. A streamlined carrying case, included at no extra charge, accommodates the tester, instruction book, probe and leads. Operates on 110-120 volt 60 cycle. Only

\$42.50
NET

SHIPPED ON APPROVAL
NO MONEY WITH ORDER — NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — **NO INTEREST OR FINANCE CHARGES ADDED**. If not completely satisfied, return to us, no explanation necessary.

See page 117 for complete details

MOSS ELECTRONIC DIST. CO., INC. 3849 TENTH AVE., NEW YORK 34, N.Y.

SUPERIOR'S NEW MODEL 79

The Most Versatile All-Purpose Multi-Range Tester Ever Designed!

SUPER-METER WITH NEW 6" FULL-VIEW METER

A Combination VOLT-OHM MILLIAMMETER.

Plus CAPACITY, REACTANCE, INDUCTANCE AND DECIBEL MEASUREMENTS.

Also Tests SELENIUM AND SILICON RECTIFIERS, SILICON AND GERMANIUM DIODES



Model 79 comes complete with operating instructions and test leads. Use it on the bench—use it on coils. A streamlined carrying case included at no extra charge accommodates the tester, instruction book and test leads. Only

\$38.50 NET

The Model 79 represents 20 years of continuous experience in the design and production of SUPER-METERS, an exclusive SICO development.

In 1938 Superior Instruments Co. designed its first SUPER-METER, Model 1150. In 1940 it followed with Model 1250 and in succeeding years with others including Models 670 and 670-A. All were basically V.O.M.'s with extra services provided to meet changing requirements.

Now, Model 79, the latest SUPER-METER includes not only every circuit improvement perfected in 20 years of specialization, but in addition includes those services which are "musts" for properly servicing the ever increasing number of new components used in all phases of today's electronic production. For example with the Model 79 SUPER-METER you can measure the quality of selenium and silicon rectifiers and all types of diodes—components which have come into common use only within the past five years, and because this latest SUPER-METER necessarily required extra meter scale, SICO used its new full-view 6-inch meter.

Specifications

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500.

A.C. VOLTS: 0 to 15/30/130/300/1,500/3,000.

D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.

CAPACITY: 001 to 1 Mfd. 1 to 50 Mfd.

REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to

2.5 Megohms.

INDUCTANCE: .15 to 7 Henries, 7 to 7,000 Henries.

DECIBELS: -6 to +18, +14 to +38, +34 to +38.

The following components are all tested for QUALITY at appropriate test potentials. Two separate BAD-GOOD scales on the meter are used for direct readings.

All Electrolytic Condensers from 1 MFD to 1000 MFD.

All Selenium Rectifiers.

All Germanium Diodes.

All Silicon Rectifiers.

All Silicon Diodes.

For the first time ever: ONE TESTER PROVIDES ALL THE SERVICES LISTED BELOW!

Superior's
New Model **76**



RESISTANCE BRIDGE SECTION

2 Ranges: 100 ohms to 5 megohms.
Resistance can be measured without disconnecting capacitor connected across it. (Except, of course, when the R C combination is part of an R C bank.)

IT'S A
CONDENSER BRIDGE
with a range of .00001 Microfarad to 1000 Microfarads
(Measures power factor and leakage too.)

IT'S A
SIGNAL TRACER

which will enable you to trace the signal from antenna to speaker of all receivers and to finally pinpoint the exact cause of trouble whether it be a part or circuit defect.

CAPACITY BRIDGE SECTION

4 Ranges: .00001 Microfarad to 1000 Microfarads. Will also locate shorts, and leakages up to 20 megohms. Measures the power factor of all condensers from .1 to 1000 Microfarads. (Power factor is the ability of a condenser to retain a charge and thereby filter efficiently.)

TV ANTENNA TESTER SECTION

Loss of sync, snow and instability are only a few of the faults which may be due to a break in the antenna, so why not check the TV antenna first? 2 Ranges: 2' to 200' for 72 ohm coax and 2' to 250' for 300 ohm ribbon.

IT'S A
RESISTANCE BRIDGE
with a range of 100 ohms to 5 megohms

IT'S A
TV ANTENNA TESTER
The TV Antenna Tester section is used first to determine if a "break" exists in the TV antenna and if a break does exist the specific point (in feet from set) where it is.

SPECIFICATIONS:

SIGNAL TRACER SECTION

With the use of the R.F. and A.F. Probes included with the Model 76, you can make stage gain measurements, locate signal loss in R.F. and Audio stages, localize faulty stages, locate distortion and hum, etc. Provision has been made for use of phones and meter if desired.

Model 76 comes complete

with all accessories includ-

ing R.F. and A.F. Probes;

Test Leads and operating

instructions. Nothing else

to buy. Only

\$26.95
NET

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NO MONEY WITH ORDER—NO C.O.D.

Try for 10 days before you buy! If completely satisfied, send down payment after trial and pay balance at indicated monthly rate — **NO INTEREST OR FINANCE CHARGES ADDED**
If not completely satisfied, return to us, no explanation necessary.

See facing page for complete details

MOSS ELECTRONIC DIST. CO., INC. 3849 TENTH AVE., NEW YORK 34, N. Y.

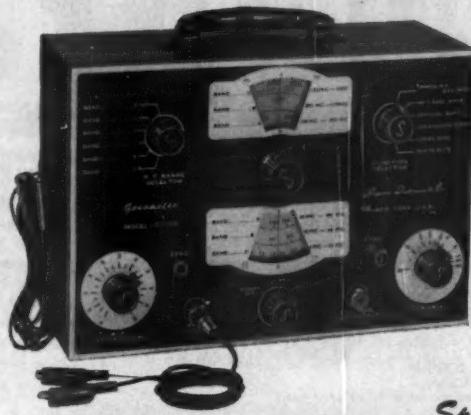
Superior's New
Model TV-50A

GENOMETER

7 Signal Generators in One!

- ✓ R.F. Signal Generator for A.M.
- ✓ R.F. Signal Generator for F.M.
- ✓ Audio Frequency Generator

- ✓ Bar Generator
- ✓ Cross Hatch Generator
- ✓ Color Dot Pattern Generator
- ✓ Marker Generator



R.F. SIGNAL GENERATOR:

The Model TV-50A Genometer provides complete coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. Accuracy and stability are assured by use of permeability trimmed Hi-Q coils. R.F. is available separately, modulated by the fixed 400 cycle sine-wave audio or modulated by the variable 300 cycle to 20,000 cycle variable audio. Provision has also been made for injection of any external modulating source.

VARIABLE AUDIO FREQUENCY GENERATOR:

In addition to a fixed 400 cycle sine-wave audio, the Model TV-50A Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. This service is used for checking distortion in amplifiers, measuring amplifier gain, trouble shooting hearing aids, etc.

BAR GENERATOR:

This feature of the Model TV-50A Genometer will permit you to throw an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. A Bar Generator is acknowledged to provide the quickest and most efficient way of adjusting TV linearity controls. The Model TV-50A employs a recently improved Bar Generator circuit which assures stable never-shifting vertical and horizontal bars.

CROSS HATCH GENERATOR:

The Model TV-50A Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, hori-

This versatile All-Inclusive GENERATOR Provides ALL the Outputs for Servicing:

- A.M. RADIO • F.M. RADIO
- AMPLIFIERS
- BLACK AND WHITE TV
- COLOR TV

Specifications

zontal and vertical lines interlaced to provide a stable cross-hatch effect. This service is used primarily for correct ion trap positioning and for adjustment of linearity.

DOT PATTERN GENERATOR (For Color TV)

Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50A will enable you to adjust for proper color convergence. When all controls and circuits are in proper alignment, the resulting pattern will consist of a sharp white dot pattern on a black background. One or more circuit or control deviations will result in a dot pattern out of convergence, with the blue, red and green dots in overlapping dot patterns.

MARKER GENERATOR:

The Model TV-50A includes all the most frequently needed marker points. Because of the ever-changing and ever-increasing number of such points required, we decided against using crystal holders. We instead adjust each marker point against precise laboratory standards. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc. (3579 Kc. is the color burst frequency.)

The Model TV-50A comes absolutely complete with shielded leads and operating instructions. Only

\$47.50
NET

SHIPPED ON APPROVAL NO MONEY WITH ORDER - NO C.O.D.

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. D-525, 3849 Tenth Ave., New York 34, N. Y.

Please send me the unit checked on approval. If completely satisfied I will pay on the terms specified with no interest or finance charges added. Otherwise, I will return after a 10 day trial positively cancelling all further obligation.

Name
Address
City Zone State

All prices net, F.O.B., N. Y. C.

<input type="checkbox"/> Model 79	\$8.50 within 10 days. Balance \$1.00 monthly for 3 months.	Total Price \$38.50
<input type="checkbox"/> Model TW-11	\$11.50 within 10 days. Balance \$1.00 monthly for 6 months.	Total Price \$47.50
<input type="checkbox"/> Model 77	\$12.50 within 10 days. Balance \$1.00 monthly for 5 months.	Total Price \$62.50
<input type="checkbox"/> Model TV-50A	\$11.50 within 10 days. Balance \$1.00 monthly for 5 months.	Total Price \$47.50
<input type="checkbox"/> Model TV-12	\$12.50 within 10 days. Balance \$1.00 monthly for 6 months.	Total Price \$52.50
<input type="checkbox"/> Model 76	\$11.50 within 10 days. Balance \$1.00 monthly for 5 months.	Total Price \$47.50
		\$5.00 within 10 days. Balance \$1.00 monthly for 4 months.

**FAST!
ACCURATE!**

SECO Test Equipment

Saves time . . . makes
more money for you!

WRITE TODAY FOR COMPLETE
SPECIFICATIONS AND FEATURES!

- Outstanding Reliability and Performance!
- Unique, Time-Saving Features!
- Low First Cost Makes You Money From the Start!

107 TUBE TESTER—
Outstanding performance and accuracy—provides 3 important tests: amplifier types tested for gain by Dynamic Mutual Conductance method—power types tested for cathode current by Cathode Emission method—all types tested for shorts and grid error by Grid Circuit Test developed and patented by Seco. Dynamic Mutual Conductance Test pre-wired to eliminate elaborate set-up. Cathode Emission Test done by free point pin-selector method will not be obsoleted. Completely self-contained in portable carrying case. Furnished with handy flip chart for fast tube set-up data.

MODEL 107 \$139.50 NET



atly. Electron eye tube indicates faults at a glance. As many as eleven simultaneous checks—automatically.

MODEL GCT-S—Kit \$19.95 NET

MODEL GCT-B—Wired & tested. 29.95 NET

208TVTM—"Fool-proof"—many new features! Easy-to-read 4½" 200 microamp meter mounted on sloping panel—7 DC, 7 AC, 7 ordinary Ohm ranges, plus RETMA (EIA) Ohm scale to check standard color-coded resistance values and tolerance limits. Specially designed "shift-lever" type function switch identifies and automatically connects proper probe. With stand, 40' leads, and common lead with clip.

MODEL 208 \$74.50 NET
Leather, felt-lined carrying case. \$9.95 NET

PS-2 BATTERY ELIMINATOR—Compact unit places of battery normally used to operate and service low-powered transistorized equipment. Supplies clean, filtered DC—can't be damaged by a short. Quickly spots faulty batteries by substitution. Output continuously variable from 0 to 15 V.—ideal for experimenters. Complete with jacks, leads, and clips.

MODEL PS-2 \$13.95 NET
FB-4 FLYBACK CIRCUIT AND INDUCTANCE ANALYZER—Quick "yes" or "no" answer on condition of flyback transformer and yoke—100% accuracy! Resonant frequency and "Q" meter principle used—will not be obsoleted. No disconnecting—no charting—checks complete horizontal coil circuit. Complete with self-contained power supply and matched 18" leads.

MODEL FB-4 \$38.95 NET

FP-1 FILAMENT CONTINUITY CHECKER AND 90 VOLT BIAS SUPPLY PACK—Checks continuity of TV and radio-type tubes—perfect for many bias substitution jobs.

MODEL FP-1 \$12.95 NET
Get the complete story on Seco's exciting line of test equipment. See your distributor—or write for complete information today!

SECO MANUFACTURING CO.
5015 Penn Avenue So.
Minneapolis, Minn.

New Tube Tester Data

Owners of RCA hole-card automatic testers: here are hole locations to be punched for new tubes.

RCA AUTOMATIC TESTER, WT-110A

TUBE TYPE	HOLE LOCATIONS TO BE PUNCHED	NOTES
1AG5 Pentode Unit	G1, E2, B4, D5, A6, M6, N6, M2, N1, L5, J7, K10	
1AG5 Diode Unit	B1, B2, G3, B4, B5, A6, M6, N6, M2, N1, L3, K10	Reject if below 3
1G3-GT/1B3-GT	Use 1B3-GT Card	Reject if below 2
I2Z	A4, B5, G10, M6, N5, N3, L4, K10	Reject if below 3
2E30	D1, B2, A3, A4, G5, E6, B7, M6, N6, M2, N4, L1, J9, K4	Reject if below 3
2E35	G1, E2, B3, D4, A5, M6, N6, M2, N1, L5, J7, K10	Reject if below 3
2E36	Use 2E35 Card	
2C51	Use 5670 Card	
2X2-A	A1, B4, C10, M6, N6, M2, N4, L5, K6, K7, L6, L7	Reject if below 4
3B2	A2, B7, G10, M6, N6, M4, N2, L5, K9	Reject if below 4
6AB7/1853	B1, A2, B3, D4, C5, E6, B7, G8, M10, N9, M5, N2, L1, J3, J6, I6, I10, K6, L6, L7	Reject if below 4
6AJ8/ECH81	B1, B2, C3, A4, B5, B6, B7, G8, D9, M10, N9, M5, N2, L1, J1, J2, I8, I10, K7, K8, L6, L7	Reject if below 3
Triode Unit	E1, D2, C3, A4, B5, G6, B7, B8, B9, M10, N9, M5, N2, L1, J4, I6, I9, K3, K4	Test P1 and P2
6AJ8/ECH81	Use 6T8 Cards	
Heptode Unit	Hole locations same as present card	
6AK8/EABC80	F1, D2, A3, C4, C5, B6, D7, G8, M10, N9, M5, N2, L1, J1, I8, I10, K5, K6, L6, L7	Reject if below 3
6AX4-GT	D2, C3, A4, B5, G7, E9, M10, N9, M3, N1, L1, J6, I10, K7, L6, L8	Test P1 and P2
6BG7	B1, A2, G3, E4, D5, B7, C8, M10, N9, M4, N2, L1, J8, I6, I10, K7, L6, L8	
6BQ5/EL84	A2, F2, C4, D4, G6, B7, C8, D10, M10, N9, M5, N2, L1, J4, I6, I9, K3, K4	
6CA7/EL34	Use 6T8 Cards	
6C8-G	Hole locations same as present card	
6CX8 Pentode Unit	F1, D2, A3, C4, C5, B6, D7, G8, M10, N9, M5, N2, L1, J1, I8, I10, K5, K6, L6, L7	Reject if below 3
6CX8 Triode Unit	D2, C3, A4, B5, B6, D7, G8, M10, N9, M3, N1, L1, J1, I6, I10, K7, L6, L8	Test P1 and P2
6CE5	C1, D2, G3, A4, B5, B6, B7, B8, B9, M10, N9, M3, N1, L1, J1, I6, I7, K8, L6, L8	
6DA6/EF80	E1, D2, A4, B5, C7, M10, N9, M5, N2, L1, J8, I6, I9, K9, K10, L6, L8, G9	
6DB5	B1, D2, C3, A4, B5, B6, G7, E8, B9, M10, N9, M5, N2, L1, J1, I6, I10, K6, K7, L6, L7	
6DS5	J4, E6, I10, K6, K7, L6, L7	
6K5-GT	D1, C2, A3, B4, G5, E6, M10, N9, M3, N1, L1, J7, I6, I10, K4, K5, L6, L7	
6L6-GB	B1, A2, B3, D4, C5, E6, B7, G8, M10, N9, M5, N2, L1, J4, I6, I10, K6, K7, L6, L7	For gas test, see tester instructions
6SD7-GT	Hole locations same as present card	
6W4-GT	A1, G2, E3, B4, B5, D6, C7, B8, M10, N9, M5, N2, L1, J2, I6, I10, K7, K8, L6, L7	Reject if below 3
7L7	A1, C2, D3, A4, B5, G9, M10, N9, M3, N1, L1, J1, I6, I7, K8, L6, L8	
10DE7 Triode 1	G1, D3, A4, B5, C6, E8, M10, N8, M5, N1, L1, J5, I6, I10, K2, K3, L6, L7	
10DE7 Triode 2	See 5847 Card	
12DB5	See 5842 Card	
25BK5	A1, E2, D3, C4, B5, G10, M10, N9, M3, N1, L1, J9, I6, I10, K2, K3, L6, L7	
404-A	A1, E2, D3, C4, B5, G10, M10, N9, M3, N1, L1, J9, I6, I10, K2, K3, L6, L7	
417-A	Use 6L6 G card	
807	A1, B2, G10, M6, N6, M2, N1, L4, K8, K9	Reject if below 3
1614	A1, C2, D3, F4, B5, G6, D7, C8, B9, M10, N9, M5, N2, L1, J1, K5, K6, L6, L7	Test P1 and P2
5642	G1, A2, D3, B4, M6, N6, M2, N1, L1, J7, K3	
5670	G1, C2, A4, B5, E6, C7, D8, M10, N9, M5, N2, L1, J6, I6, I10, K4, L6, L7	
5676	G1, A3, D4, C6, B9, M10, N9, M5, N2, L1, J1, I7, I9, K4, L6, L8	For gas test, see tester instructions
5763	G1, A3, D4, C6, B9, M10, N9, M5, N2, L1, J1, I7, I9, K4, L6, L8	
5842/417A	G1, A3, D4, C6, B9, M10, N9, M5, N2, L1, J1, I7, I9, K4, L6, L8	
5847/E182F/404A	D1, B3, C4, G6, E8, A9, M10, N9, M5, N2, L1, J1, I8, I10, K7, L6, L8	Test P1 and P2, reject if below 4
5879	D1, C3, A4, B5, E7, G8, C9, M10, N9, M5, N2, L1, J6, I6, I10, K8	Test P1 and P2
5896	F1, C2, A3, B4, G5, B6, C7, M10, N9, M5, N2, L3, I6, I10, K7, K8, L6, L8	Test P1 and P2
5903	F1, D2, C3, A4, B5, G6, D7, C8, M10, N9, M2, N3, L1, J1, I6, I10, K7, K8, L6, L7	Test P1 and P2
5904	F1, G2, A3, B4, D5, D6, C7, M10, N9, M5, N2, L1, J1, I7, I9, K4, L6, L7	Test P1 and P2
6021	F1, D2, A3, C4, B5, B6, D7, G8, M10, N9, M5, N2, L1, J1, I6, I8, K4, L6, L7	Test P1 and P2
6146	G1, A2, E3, D5, B7, G10, M10, N9, M3, N1, L1, J1, I9, I10, K3, K4, L6, L7	Test P1 and P2
6159	G1, A2, E3, D5, B7, G10, M10, N8, M3, N1, L1, J1, I9, I10, K3, K4, L6, L7	Test P1 and P2

48¢ ea. for any tube

\$45.00 Per Hundred

STANDARD LINE

ELECTRIC
COMPANY

FREE POSTAGE IN U.S.A. & TERRITORIES

FREE TUBE BRIGHTENER ON ORDERS
OF \$10.00 OR MORE

ANNOUNCING OUR NEW PRICE SCHEDULE

Effective July 25, 1958 all tubes (Radio & Television receiving) will be sold and shipped at the fantastic price of only .48c ea. or \$45.00 per hundred. Any "on hand" orders at that time will receive credit for future purchases.

THE TUBES ADVERTISED HEREIN ARE NOT NECESSARILY NEW TUBES BUT MAY BE ELECTRICALLY PERFECT FACTORY SECONDS OR USED TUBES AND ARE SO MARKED.

All TV & Radio Tubes are tested by our supplier under actual conditions in Radio & TV chassis or in Hickock Tube Testers Model 533A.

And, of course, the famous Standard Line guarantee remains in effect: All tubes guaranteed to be replaced free if they fail to function efficiently within one year's time. (defective tubes must be returned intact, postage paid. Refunds will be cheerfully made within five (5) days if not completely satisfied.)

6R2	5A1S	5V4GT	4R6	654	777	12Q7	32L7GT
0Z4	3AU6	5W4GT	6R5	658GT	778	12A7	35/51
1ASGT	3AV6	5X4G	6R6G	658T	787	12507	35AS
1A7GT	3BA6	5X8	6R16	6587	797	12517	35BS
1B3GT	3BC5	5Y3GT	6R8H	65C7	737	125K7	35CS
1C5GT	3BE5	5Y4G	6R16	65F5	7K7	125N7GT	35L6GT
1C6	3BN6	5Z3	6R8K	65F7	717	125Q7	35W4
1C7	3BU8	5Z4	6R7	65H7	7K7	125R7	35Y4
1H4G	3BY6	6A8	6R17GT	6S17	7Q7	12V60T	3524GT
1H5GT	3BZ6	6A84	6R86	6S17	787	12W66T	3523GT
1L6	3C2	6A7	6R04GT	6S17GT	757	12X4	#37
1LA4	3CB6	6A7F	6R07	6S17GT	777	12Z3	#39/44
1LA6	3CF6	6A9S	6R8B	6SQ7	7W7	14A67	#41
1LB4	3CS6	6A97	6R88	6S27	7X6	14AF7	#42
1LC5	3DT6	6A94GT	6R75G	6T4	7X7	14B4	#43
1LC6	3D4	6A96	6R26	6T8	7Y4	14F7	#45
1LH4	3D3GT	6A95	6S27	6U4GT	724	14F8	#47
1LN5	3E4	6A96	6C4	6U3	8AWB	14H7	50AS
1NSGT	3F4	6A1S	6C5	6U8	12AB	14N7	50BS
1PSGT	4PC8	6A17GT	6C85	6V3	12AB5	14Q7	50CS
1TSGT	4BQ7A	6A8B	6C86	6V6GT	12AQ5	14S7	50C6G
1RS	4BS8	6A8B	6CD4G	6W4GT	12AT6	17AX4GT	50L6GT
1SS	4BU8	6AQS	6C6	6W6GT	12AT7	17D06	50Y6
1T4	4BZ7	6AQ6	6C07	6X4	12AU6	19A4	50Y7
1TSGT	4CB6	6A97GT	6C08	6X5GT	12AU7	19B6GG	#57
1U4	5A8H	6A9S	6CMB	6X8	12AV6	19C8	#58
1U5	5A9S	6A5S	6C16	6Y6G	12AV7	19J6	#60
1V	5AQS	6A5B	6CM6	744	12AX4GT	19T8	#61
1V2	5ASB	6AT6	6CM7	7A5	12AX7	19X8	117L7GT
1X2	5AT8	6AU4GT	6CN7	7A6	12AZ7	25AC5	117N7GT
2A3	5AVB	6AU5GT	6CU6	7A7	12B4	25AV5GT	117P7GT
2A5	5AW4	6AU6	6D66	7A8	12B46	25AX4GT	117Z3
2A7	5AZ4	6AU8	6D66	7B4	12B66	25BK5	117Z4GT
2AF4A	5BK7	6AV3GT	6DT6	7B5	12BF6	25BQ6	117Z4GT
2B7	5BB8	6AV6	6E5	7B6	12BH7	25CD6	807
2BN4	5BQ7	6AWB	6F16	7B7	12BK5	25C16	9002
2D21	5BZ7	6AX4GT	6J4	7B8	12BQ6	25I6GT	9003
2E5	5CG8	6AX5GT	6J5	7C4	12BR7	25W4GT	9006
2X2A	5J6	6AZB	6J6	7C5	12CA5	25Z5	
3A2	5T8	6BA6	6K4GT	7C6	12CU6	23Z6	
3A3	5U6	6BC5	6J7	7C7	12DQ6	#27	
3A4	5U4D	6BC8	6J6	7E6	12JS	#30	
3A5	5V4D	6BD6	6J7	7E7	12L60T	#31	

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the ultra-linear II



All of the working controls, jacks, and plugs are mounted on the front panel.

A new 60-watt power amplifier kit that employs an unusual feedback circuit with exceptional stability.

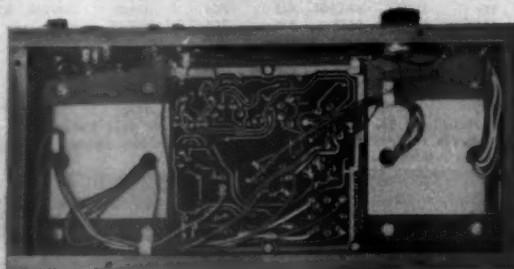
WE HAVE TESTED quite a large number of high-power amplifiers and presented our reports in past issues of RADIO & TV NEWS. As a general rule, we have found most amplifiers in this classification quite similar as far as performance is concerned, specifically regarding harmonic and intermodulation distortion. Variations involved mostly appearance, special features, and, of course, cost.

The results obtained from the "Ultra-Linear II," which is being marketed in kit form by Acro Products Company of Philadelphia, are similar in many respects to the other amplifiers tested, but the design incorporates a novel method of obtaining feedback. It is a new method and its greatest advantage is that it provides an especially good stability factor. The manufacturer believes that the advantages are so great that many future designs from other companies may incorporate this technique.

Almost all recent amplifiers use a voltage feedback loop from the secondary of the output transformer back to the first stage of the power amplifier. In these designs the degree of stability is dependent upon the type of load connected to the output. Extreme-

ly high capacities, usually due to long lines or extreme variations of voice-coil impedances with frequency, result in phase shifts that may cause oscillation. Although this is a major problem in all feedback amplifier designs, it is not a serious one. Most amplifiers on the market today have a sufficiently large stability factor to a point that, if they are used under reasonable conditions, they will present no problems. On the other hand, should anyone desire to go to the extreme and, for example, use an electrostatic speaker which is basically capacitive in load, some power amplifiers would encounter difficulties.

The new Acro method, which has been called "hybrid" feedback, does not employ feedback directly from the secondary winding of the output transformer. It does incorporate a separate winding which is tightly coupled to both primary and secondary windings and is connected to the secondary in series-aiding. It is this winding that supplies all the necessary voltage and current feedback. The diagram clearly shows how this particular type of feedback is used across all three stages. It is of considerable interest to note that this new design, since it



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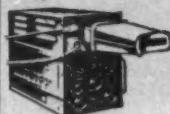
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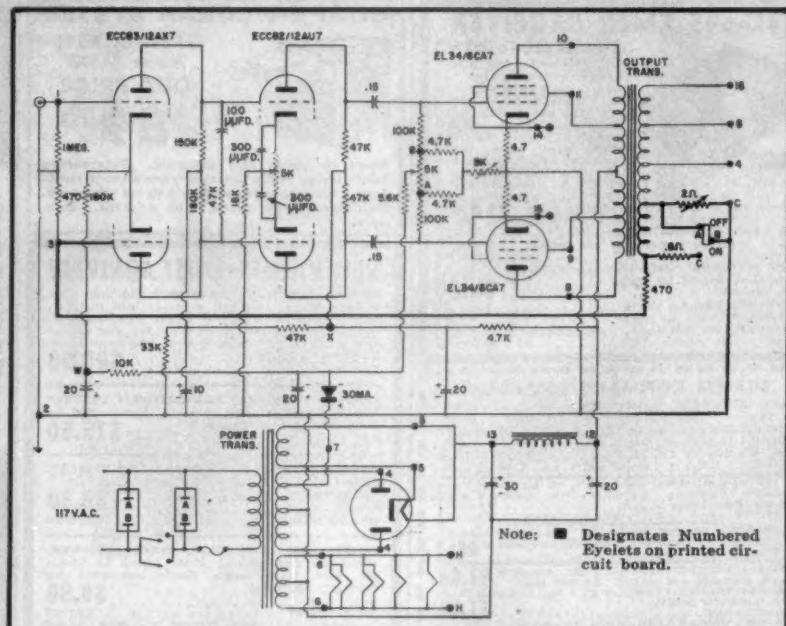


Diagram of the 60-watt power amplifier. Note particularly the feedback loop.

does not tie in directly with the secondary winding of the transformer, is not readily affected by variations in loads. It also adapts itself very nicely to a design incorporating a variable damping control. We have checked the performance of this unit and can certainly say that it is extremely stable. Unfortunately, we have not tested other power amplifiers to the degree where we could give comparative figures. The manufacturer claims that an electrostatic speaker was tried with this power amplifier and performance was excellent.

Lab Report

Sensitivity: 1.3 volts input required for maximum 60-watt output.

Hum and Noise: Down 56 db from 2 watts output, open-circuit input. For shorted input, the hum and noise is down 70 db from 2 watts.

The -70 db hum and noise figure is as good as they come. While the open-circuit value of -56 db is not of the best, it is not customary for the user to operate the power amplifier under open-circuit conditions. Improvement can be made and for those who already have a unit of this type it is not a difficult task to make the changes.

Remove the red-white and green-black wires from the ground lug to which they are connected. Run them through the power transformer cable clamp and attach to another ground lug at the nearest printed circuit board mounting screw. A new soldering lug should be used at this point and it should be soldered to the ground bus of the printed circuit board. This ground bus is a broad band of metallic material on the border of the printed circuit board nearest the ground lug. The manufacturer has recommended this

change and advises us that all future kits will incorporate this modification. In addition, a useful suggestion was passed on to us. To eliminate any possible squeal in the speaker which may occur with input plug disconnected and amplifier turned on or off, solder a 1-megohm resistor from input jack contact to its own ground terminal.

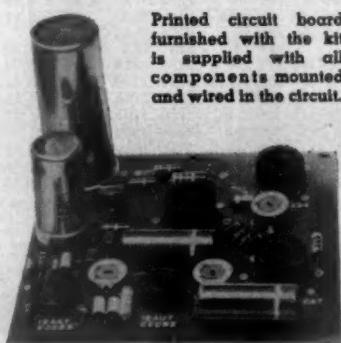
With these changes we found that the hum and noise were now down to 71 db from 2 watts output with open-input circuit.

Frequency Response: Taken at 2 watts level is ± 1 db from 7 to 52,000 cps. At maximum 60-watt output, the frequency response is flat within ± 1 db from 9 to 26,000 cps.

IM Distortion: (60 and 6000 cps, 4 to 1 ratio). For an equivalent sine-wave output of 2 watts, the IM distortion is .12%. At 60 watts the distortion is .71%. This is well within our requirement of 1% permissible distortion. In fact, the 1% figure appears at an equivalent sine-wave output of 64.68 watts.

Harmonic Distortion: At 2 watts output, .09% at 20 cps; .08% at 1000 cps; and .1% at 20 kc. We believe that

Printed circuit board furnished with the kit is supplied with all components mounted and wired in the circuit.



2% harmonic distortion is the maximum that should be permitted for ideal performance. With this assumption, the amplifier output is 63 watts at 20 cps and 51 watts at 20,000 cps. This latter figure is somewhat lower than rated output. However, we have not as yet found any amplifier which meets published specifications for this particular condition. One point worthy of comment regarding the tests is that they were taken with an 8-ohm output load. Were our tests made with 16 ohms instead, all performance characteristics listed herein would, without a doubt, show considerable improvement. This is not unusual and it applies to all power amplifiers with the exception of those designs that have separate feedback loops for each of the output taps.

Damping Factor: The damping factor varies from .35 to 7.9 with the damping control varied from minimum to maximum. The maximum figure, of course, is obtained with the damping control in "off" position. The manufacturer's figures on the damping factor, as published and as printed directly on the chassis, show a possible variation from .5 to 15. These are based on the assumption that a 16-ohm speaker load is used. We would actually have liked to have seen a maximum d.f. of 15 with an 8-ohm load as well. However, the difference from what was obtained is not really of too great significance in actual practice.

—31—

IGNITION DWELL METER

By CHARLES ERWIN COHN

An ignition dwell meter for auto tune-up can be easily assembled with a couple of electronic parts. The basic unit required is a 0-1 ma. meter. Also needed is a 7500-ohm pot and an additional 7500-ohm resistor for 12-volt automotive systems.

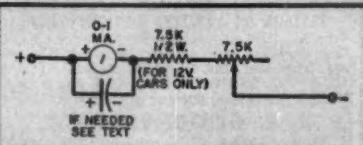
To perform the test, connect the meter, pot, and resistor (if used) in series. With the engine running, connect this combination across the battery. Adjust the pot so that the meter reads full-scale. Then, with the engine running at the same speed so the system voltage doesn't change, connect this hookup between the hot battery terminal and the distributor primary terminal.

If full-scale on the meter is 1, the point dwell angle is given by the meter reading multiplied by 90 degrees for a 4-lobe cam, by 60 degrees for a 6-lobe cam, or by 45 degrees for an 8-lobe cam.

Milliammeters with other ranges can be used if the resistor and pot values are changed accordingly. If the pointer tends to swing wildly, a high-capacitance, low-voltage electrolytic across the meter will steady it.

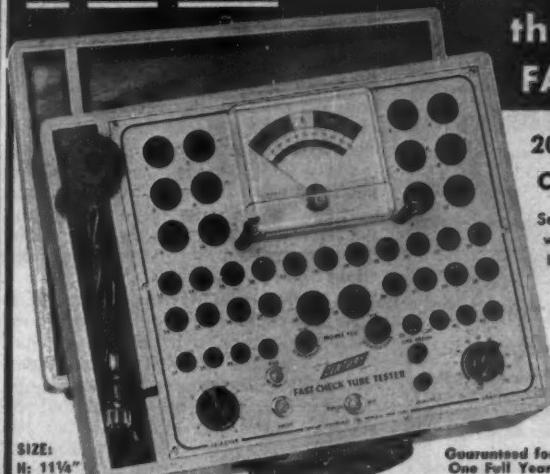
—31—

Simple set-up for automotive tune-ups.



October, 1958

NO OTHER TUBE TESTER MADE-AT ANY PRICE-can MATCH the VALUE of the CENTURY FAST-CHECK



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H: 11 1/4"
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See for yourself—AT NO RISK—why over 20,000 servicemen selected the FAST-CHECK above all other tube testers—regardless of price. With the FAST-CHECK you will make every call pay extra dividends by merely showing your customer the actual condition and life expectancy of the tube. The extra tubes you will sell each day will pay for the FAST-CHECK in a very short time.

Just 2 settings on the
FAST-CHECK TUBE TESTER
tests over 650 tube types completely,
accurately—and in seconds!

PICTURE TUBE TEST ADAPTER INCLUDED WITH FAST-CHECK

Enables you to check all picture tubes (including the new short-neck 110 degree type) for cathode emission, shorts and life expectancy . . . also to rejuvenate weak picture tubes. This feature eliminates the need of carrying extra instruments and makes the FC-2 truly an all-around tube tester.

FAST-CHECK'S low price is made possible because you are buying direct from the manufacturer.

COMPARE FAST-CHECK WITH OTHER TESTERS RANGING FROM \$40 TO \$200

RANGE OF OPERATION

- ✓ Checks quality of over 650 tube types, which cover more than 99% of all tubes in use today, including the newest series-string TV tubes, auto 12 plate-volt tubes, OZ4s, magic eye tubes, gas regulators, special purpose tubes, hi-fi tubes and even foreign tubes.
- ✓ Checks for inter-element shorts and leakage.
- ✓ Checks for gas content.
- ✓ Checks for life-expectancy.

Other testers may have some of the above features . . . but only the FAST-CHECK has them all!

IMPORTANT FEATURES

- Checks each section of multi-section tubes and if only one section is defective the tube will read "Bad" on the meter scale.
- Less than 10 seconds to test any tube.
- 41 long lasting phosphor-bronze tube sockets accommodate all present and future tube types . . . cannot become obsolete.
- 7-pin and 9-pin straighteners mounted on panel.
- Large D'Arsonval type meter is extremely sensitive yet rugged—fully protected against accidental burn-out.
- Special scale on meter for low current tubes.
- New tube listings furnished periodically at no cost.
- Compensation for line voltage variation.

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Dept. 210, 111 Roosevelt Ave., Mineola, N. Y.

Rush the FAST-CHECK for a 10 day trial period. If not completely satisfied I will return the instrument within 10 days without further obligation. If fully satisfied I agree to pay the down payment within 10 days and the monthly installments as shown. No financing charges are to be added.

Model FC-2 . . . \$69.50 — Pay \$14.50 within 10 days. Balance \$11.00 monthly for 5 months.

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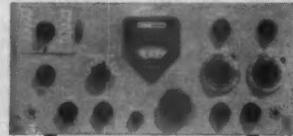
City..... State.....

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THE LATEST FROM *Collins*

Collins KWM-1



first SSB transceiver for complete Mobile or Fixed use

The revolutionary KWM-1, the first mobile transceiver to offer SSB. And this 14-30 mc 175 watt package is equally adaptable to fixed use with simple removal from a convenient mounting tray under the dashboard.

Utilization of common components in both transmitting and receiving functions results in a saving of both space and cost and, in the case of frequency-determining components, assures exact coincidence of transmitted and received signals. Frequency stability and readability is comparable to that of the KWS-1/75A-4. The panel meter serves as an S-meter during receive and multiplier during transmit. Broadcast CW using VOX circuit in built-in, as is a side tone for monitoring CW. Ten 100 kc bands are available anywhere in the 14-30 mc range.

NET PRICES

KWM-1 Transceiver	\$820.00
516E-1 12 vdc Power Supply	262.00
516F-1 115 vac Power Supply	136.00
312B-2 Speaker Console with phone patch and directional wattmeter	205.00
312B-1 Speaker in cabinet	25.00
351D-1 Mobile Mounting Tray	98.00

Also in stock the complete Collins line of ham gear.

TRANSCON

A complete mobile phone station in your car! Simply connect to your car radio. Choose 6 or 10 meter band model. Ideal for CD. Only 5x5x7 in. Choice of 6V or 12V types. Easily installed. \$99.50



This compact TNS (4x2 1/4 x 2 1/4 in.) features a 12AX7 and 6AL5, powered by your car radio. \$12.95

A small (4x2 1/4 x 2 1/4 in.), simple Field Strength Meter for mobile or ham use. Only \$11.95



Cerco STANDING WAVE REFLECTOMETER

FOR 52-OHM COAX

Here's a high quality device for continuous measurement of standing waves on transmission lines. Suitable for frequency range from 3 to 200 mc. See the article in QST June '57

FEATURES: Uses sensitive 0-100 microamp meter. For continuous line insertion. Power to 1000 watts and over. Prevents false reading from antenna tuner, match box, PI network. SWR observed immediately at all times without adjustment.

Whether you have an APO or foreign address HARVEY's excellent packing and shipping department assures you of perfect arrival of merchandise anywhere in the world.

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Established 1927

HARVEY RADIO CO., INC.

103 West 43rd St., New York, N. Y.

JUDSON 2-1500

Mac's Service Shop

(Continued from page 64)

An easily measured resistance of several thousand ohms was indicated.

It took Mac only a few minutes to get a duplicate transformer from stock and install it in the receiver. Barney always enjoyed watching his boss work. The man's big hands moved as confidently and surely as those of a surgeon and there was absolutely no waste motion. The wires were connected and neatly soldered so that the new solder connections could not be detected from those done at the factory.

As soon as the set was turned on, it was apparent the trouble had been found and eliminated. The receiver had lost its unique squelch effect. Weak and strong stations both were tuned in smoothly. Mac carefully aligned the whole i.f. system and touched up the oscillator and r.f. trimmers. The receiver worked perfectly; so he wiped out the plastic case and put the chassis into it.

"Oh don't look so smug!" Barney erupted. "How did the i.f. transformer produce that odd effect?"

"You should be able to figure it out. What would be the effect of that leakage between windings?"

"I suppose the 'B-plus' on the primary would put a positive potential on the diode plate."

"Right. And that would make the diode conduct and virtually short-circuit the secondary until enough signal appeared across the secondary to override the positive bias."

"What caused the leakage?"

"I think it is a little moisture that gets into the capacitors molded into the base of the transformer. At least I have been able to cure it temporarily by baking the transformer for a few hours under a heat lamp."

"So-o-o-o! You knew all along what was wrong. How come you went through all that rigamarole with the signal tracer and the v.t.v.m.?"

"Because I wasn't sure. Actually, this condition is more often brought on by a defective tube than it is by an i.f. transformer; but during the hot summer months I noticed a small rash of this particular kind of transformer trouble. When it happens to an input transformer, the symptom is more likely to be low gain and an intermittent crackling noise. I used the signal tracer and the v.t.v.m. because I always try to follow a logical procedure in running down an unusual symptom."

"We surely are doing a lot of work on these little receivers," Barney said. "I believe people are listening to radio a lot more than they did a year or so ago."

"That's right, but it's a specialized kind of listening. The kids listen to a favorite disc jockey; the woman listens to morning programs in the kitchen; Pop listens to the ball games. And incidentally, it does not hurt a bit to inquire casually what stations are fa-

YOU OWN 80%



of this Brand New
HALLCRAFTERS
All-Band Communi-
cations Receiver
R-45/ARR-7
Your taxes helped
Signal Corps pay
\$750 for the best
possible value.
In factory-packed
sealed cartons.

So pay only 20%!

READY TO PLUG INTO 115 v. 50/60 cy LINE, AND USE. You get cords, plugs, and power supply for all receiver voltages including dc for automatic tuning. 550 kc to 43 mc continuous in 6 spread-out bands. Factory aligned and calibrated. Ready to use.

• Sensitive . . . 2—6SK7 RF's, 6SA7 mixer, 2—6SK7 IF's. • Selective . . . 3 Crystal-Filter and 3 IF-pass switch positions, plus Crystal Phasing knob. • Noise-Limiter . . . switch in 6MHz pip-clipper network. • Drift-free . . . VR150 regulates the separate 6SA7 oscillator. • S-Meter . . . adjustable; 6 db/unit. • BFO . . . separate 6J5 and Pitch control. • AVC or MVC . . . AF and RF Gain controls. • Standby switch. • AF . . . 6S87 and 6S6 to hi-impedance phones. • Video . . . coax SO plug shows AF on any scope. • Pan-
oamic . . . 30 plug feeds 455 kc to any standard Panadapter. • Dial . . . large, easy-reading, back-lighted, translucent. • Tuning . . . hand-crank vernier knob or lazy-man's automatic-reversing slow-motion motor. • Yes get . . . Tech Manual, schematic, alignment dope.

Send only \$14.95 with order, balance \$12.55/mo., 12 mos.

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Either, FOB Los Angeles, is only . . .

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BARGAIN POWER AT VARIABLE VOLTAGE

UTC 31029 or equal MIL Spec T-27 Grade 1 Class A HS Transformer, 50/60 cy, 95, 117, 130, 190, 210, 234, 260v. Sec. 's 305-0-305v .15A; 6.3v 5A; 5v 3A; 7.5v 2A; 7.5v 2A. Very sec. outputs with pri. taps. Example: 95, 117, 130v taps give 123%, 100%, and 90% to any sec. or series'd sec. combo. 4½" dia., 5½" high. 20 bottom lugs. NEW FOB Chicago, only . . .

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T-47/ART-13, the 10-channel Autotune or Manual, 2 to 18.1 mc, with 813 final, pi output net, crystal calib. units, etc. Autotune resetability is as accurate as crystal control. Excellent used, checked and working at peak performance, with tubes, schematic, design of an AC supply, and calib. charts.

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BC-611 (SCR-536) hand-held communicators for 1 mile or more, complete, fresh batteries, crystals, tech. manual, aligned and working on frequency you say, 3½-6 mc.

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Type 241. 5IP1 display. One of the better Dumont laboratory-type oscilloscopes. Something to treasure. Clean used, and thoroughly checked, trimmed linear, etc. Satisfaction **unconditional**. FOB Los Angeles . . .

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RADIO & TV NEWS

vorites with the family when the set is brought in. Since that new station has opened up in Garden City on 1600 kc., you want to be sure and see that the receiver will tune up to it. By the same token the station on 560 carries the ball game and you want to be certain it can be picked up. A lot of people listen to a religious station around 1110 kc. You can make them happy by peaking the set up on that frequency. The same goes for other pet stations. Ideally, of course, the receiver should be made to track perfectly clear across the band; but practically, you can usually make a noticeable improvement on a particular frequency by careful peaking of the r.f. trimmer at that frequency after you have done the best you can to get good tracking."

"Gotcha, chief!" agreed Barney.

OMNIDIRECTIONAL TWEETER

By PROF. A. V. J. MARTIN

MOST tweeters have a marked directional effect which is detrimental to good reproduction whenever the listener moves away from the axis of the speaker. To achieve good "presence", several tricks have been tried, a reasonably successful one being the use of a number of loudspeakers distributed over the several faces of the cabinet.

One very good idea involved the use of a tweeter on each of the twelve sides of a dodecahedron, but this is a rather expensive solution. A more economical method has been developed by Grundig. It calls for two speakers, bolted face to face and fed with currents opposite in phase. The whole arrangement then pulsates at the frequency of the current, giving a reasonably good approximation of a pulsating sphere, which is the best omnidirectional speaker.—H-



In order to eliminate the directional effect of a tweeter, Grundig connects two such units face-to-face and out-of-phase. Since speakers cannot be housed in cabinet, a decorative mesh is used instead.



October, 1958

Never over or underheats!

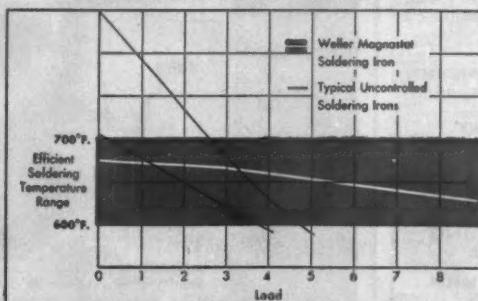
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*With built-in MAGNASTAT
Temperature Control*

A revolutionary new soldering tool from Weller—long-time leader in the soldering field. Automatically maintains correct soldering temperature—and it's all self-contained. Sensing device is in the tip. Unmatched for reliable TV, radio, printed circuit and other precision soldering. 3 models available for all your service requirements from controlled lower temperature to heavy electrical soldering. Priced from \$8.00 list, up.

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- Approximately $\frac{1}{2}$ weight of uncontrolled iron.
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MSOE—located in Milwaukee, one of America's largest industrial centers—is a national leader in electronics instruction—with complete facilities, including the latest laboratory equipment, visual aid theater, amateur radio transmitter—offers 93 subjects in electrical engineering, electronics, radio, television, electrical power, and electricity.

Advisory committee of leading industrialists. Courses approved for veterans. Over 50,000 former students. Excellent placement record. Previous educational, military, and practical experience is evaluated for advanced credit.



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Are you eligible for veterans educational
benefits?

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MS-57



In the "picture radio" a piece of drapery material is used as the picture and the set is built into the picture frame. Notice the ease with which the controls are operated at the side of the flashlight-battery-operated receiver.

Picture-Frame Transistor Set

*Mount your transistor radio behind a picture
frame in order to fit it into your home decor.*

A PICTURE-FRAME radio may be easily built by the do-it-yourselfer from many popular brand transistor radios. In the "picture radio" shown above, a piece of drapery material is used, framed by regular picture molding. The transistor radio, a regular standard model, is simply fitted behind the drapery material so that the picture is only about two and one-half inches thick and fits on the living room wall quite nicely.

The controls for the radio are mounted at the side of the frame and the dry battery holder is a plastic tube

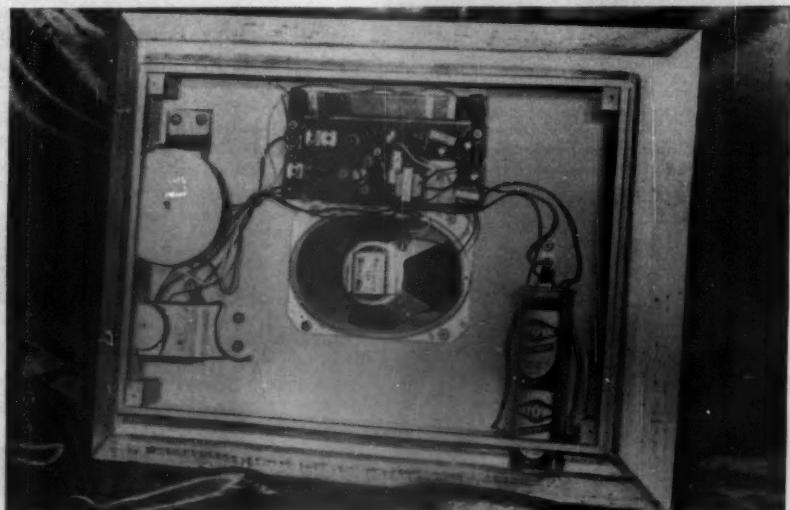
that utilizes the "flashlight loading" principle so that cells can be changed without taking the radio off the wall. The special battery holder is manufactured by *Mayfair Molded Products*, 3700 North Rose St., Schiller Park, Ill.

The idea of the "picture radio" is being considered by several manufacturers for possible inclusion in their lines of receivers.

Besides mounting a transistor set in a picture frame as shown here, it might also be possible to install the radio in a large ashtray, a planter, or other household item.

-50-

A rear view of the picture-frame transistor set is shown below. Note how the volume and station tuning controls have been mounted on brackets at the left. The knobs fit through slots in the frame. The batteries that run the set can be changed by twisting the tube and pulling down without taking radio off wall.



TELEMARINE—FOR OUTSTANDING ELECTRONIC SURPLUS

**50 WATT, 6 CHANNEL RADIOTELEPHONE
FOR BOATS OR
FIXED STATIONS**



THE RADIOTELEPHONE BARGAIN at the Pleasure and High-Speed Boat or Fixed Station. This Radiotelephone Receiver (BC-669, part of SCR-543) is beautifully and ruggedly built. Provides 6 fixed channels of crystal-controlled transmission and reception in addition to manual tuning when desired for reception of free range 1600 to 4500 KC. BC-669 FCC currently accepted 2-3 mc marine band. With recommended 110 V. DC (or 24 V. DC) dynamotor power supply it will deliver 50 watts output. Supplied with instruction book, connecting cable, power supply, constructional data, all tubes, all parts required for assembly, and complete test data. Telev. News for illustration and complete data, or send for descriptive bulletin!

EXCELLENT, as described above. **Used-Excellent**, as described above. **Shpg. wt.** \$145.00

SAME AS ABOVE, NEW-UNUSED, EACH. ... \$139.00

100 WATT POWER SUPPLY, for BC-669, includes motor, one for transmitter (100 W. at 450 ma.) and one for receiver. Produces 50/60 watts output. All wired and tested. **EACH.** ... \$89.50

DC MOTOR POWER SUPPLY KIT, Assemble and wire yourself. All material and diagram. **\$45.00**

PE-110, A, B, or C POWER SUPPLY, for 110 V. 60

DC AC operation. Like-New condition. **EACH.** ... \$89.50

HANDSET FOR ABOVE with appropriate plug connector. **Shpg. wt.** \$14.50

PAIR OF COILS, for above, RF Ant. & Osc. ... \$12.25

**30-40 MC DELUXE FM RECEIVER
FOR MOBILE POLICE & FIRE CALLS**

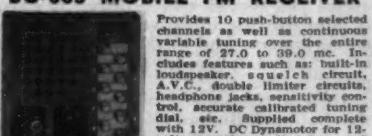


This FM receiver, the AN-B-237 part of an AN-B-237 mobile radio system, is a single channel-crystal controlled receiver for industrial, police, and fire dept. frequencies. It is of superior design and successfully combines all of the best features such as: double conversion (version 1445 KC and 4.3 inc. I.F.'s) with both oscillators and crystals controlled, built-in speaker, output, and a built-in vibrator-power supply which is designed for 6 V. DC operation. All units are practically like-new condition. Supplied with schematic diagram, and cover. Illustrated 11 1/2" x 10 1/2" x 15". Separate loudspeaker or phones (if desired) required. Supplied with tubes and schematic diagram, but less crystals, loudspeaker, etc. **Shpg. wt.** 65 lbs. **PRICE, EACH.** Not tested at this low price. **\$29.95**

TRANSMITTER COMPANION for ABOVE

Transmitter T-193/VRC-2 complements the Receiver described above, and provide FM voice transmissions in the 30 to 40 MC band. Frequency is self contained and provided a power output of 25 watts. Transmitter is same as Galvin (Motorola) type FMTR-25-VM, and is physically identical. Power supply is not shown above. Designed for operation from 6V. DC, has self-contained power supply which in some instances is Dynamotor driven. Supplied with tubes and schematic diagram. In Used-Excellent condition, in fact almost "Like-New," but are untested at the Low Price we are quoting. Supplied with tubes, schematic diagram, but less crystal or oscillator. **Shpg. wt.** 60 lbs. **PRICE, EACH.** Transmitter T-193/VRC-2, as described. **\$19.95**

BC-683 MOBILE FM RECEIVER



Provides 10 push-button selected channels as well as continuous variable tuning over the entire range of 27.0 to 39.0 mc. Includes features such as: built-in speaker, built-in microphone, headphones jacks, sensitivity control, accurate calibrated tuning, etc. Supplied complete with 110 V. DC Dynamotor for 12 volt operation, all tubes, and schematic diagram which is glued to bottom of housing case. **Shpg. wt.** 65 lbs. **PRICE, EACH.** Used-Excellent Condition. Not TESTED. **\$24.95**

PRICE, EACH. BRAND NEW, TESTED \$39.50

**BC-312, 342 SIGNAL CORPS
COMMUNICATIONS RECEIVER**

Work horse of the Signal Corps, this is a rugged communications receiver is a well known favorite of Amateurs, Communications experts, and commercial operators. Receives 1500 to 18000 KC in 6 bands. Very stable, extremely stable, and simple to operate. Has built-in BFO, heterodyne output (separate speaker required), and smooth-operation. Receptacle for antenna and ground provided. Used-Excellent Condition (untested). Act fast, our limited supply won't last long!

PRICE, EACH. Used-Excellent Condition. Not TESTED. **\$24.95**

RA-20 Power Pack for 110V AC. ... \$24.95

RA-20 Power Pack for 110V AC. ...

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...on "Load-Easy" reels
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**RADIO CORPORATION
OF AMERICA**

Electro Tube Division Harrison, N. J.

USED RECORDING TAPE (PLASTIC BASE)

ATTENTION: Radio stations, electronics dealers, television, industrial users: We have the new 1½ or 2 mil mylar "sound-plate," "lifETIME," or "P.E." tapes and we will buy or exchange your present 1 mil mylar or plastic tapes.

1.19	for 7" — 1200 ft.
.61	for 5" — 600 ft.
.37	for 4" — 300 ft.
.20	for 3" — 150 ft.

USED "MYLAR" TAPE (1 Mil)

300 ft. (3" reel)43
900 ft. (5" reel) ... 1.09
1800 ft. (7" reel) ... 2.09

New empty plastic reels in boxes: 3" 1000 ft.
225 ft. 240 ft. 7" 250 ft. 7" (4" hub, holds 1000 feet only, 49¢); 10½" fiber-glass 1.49; 10½" metal 2.24.

EMPTY BOXES: 3" 36 (folding type); 39" 2"; cover type, 5¢; 4" 5¢; 5" 5¢; 7" 5¢ ea.

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1776 Columbia Road, N.W., Washington, D.C.

3-D TV System
(Continued from page 45)

either the red or green gun to complete the required color triad. Because the luminosity of the blue field is substantially higher than that of the red and green fields, careful adjustment of the drive to each gun is necessary to obtain the proper ratio of the three color components.

Low-Cost System

If pictures of broadcast quality are not required, two *RCA* "TV-Eye" cameras and control units can be substituted for the *ITV-6* units at a substantial saving in cost.

General Considerations

An interesting fact observed in the operation of these three-dimensional television systems is that the two cameras need not have identical transfer characteristics to provide good stereoscopic viewing. It is not necessary, therefore, that the cameras be specially selected or matched. It was also found that vertical displacements of as much as $\frac{1}{8}$ inch between the red and green image fields of the 21CYP22 were not detectable through the viewing glasses.

**RADIOTELETYPEWRITER
SIGNALS BOUNCED OFF MOON**

RADIO transmission tests using the moon as a passive relay station have been conducted recently by the Signal Communications Department of the U.S. Army Electronic Proving Ground and Collins Radio Company.

These tests very probably represent the first time that intelligence, in this case radioteletypewriter, has been transmitted in the ultra-high frequency region of 1000 megacycles over the nearly 500,000-mile distance from the earth to the moon and back.

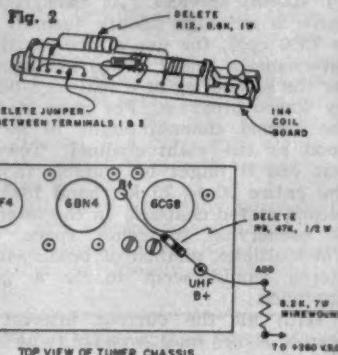
Transmitting station for the tests was located near Fort Huachuca, Arizona, and the receiver was at Encino, New Mexico. The frequency of 810 megacycles per second was utilized in order to increase the effectiveness of the antenna systems and to take advantage of lower signal losses in the transmission path.

During November 1952, Collins and the National Bureau of Standards used the moon as a reflector to relay radioteletypewriter signals from Cedar Rapids to Sterling, Virginia. In the Collins-NBS tests, an ultra-high frequency of 418 megacycles was used.

In discussing the current tests, project personnel at Fort Huachuca said this type of communication is limited in range only by the ability to observe the moon simultaneously from both the transmitting and receiving points. Some appreciation of the distance involved in this method of communication can be obtained from the fact that a signal, traveling at approximately 186,000 miles per second, requires only $2\frac{1}{2}$ seconds to travel the path from the transmitter to the moon and back.

If an artificial satellite can be utilized for this method of communication, the time of transmission and losses can be drastically reduced.

and 3 on this strip. Also remove resistor R_{10} , 5600 ohms, located on the strip, and "B+" dropping resistor R_8 , 47,000 ohms, located on top of the tuner chassis. An 8200-ohm, 7-watt, wirewound resistor is then added between the u.h.f. "B+" terminal on top of the tuner and the 260-volt source on the main chassis. This resistor may



be mounted on a convenient, unused terminal strip on top of the main chassis. That strip may be located by reason of the fact that, between it and the tuner, T_{10} may be found. Connection may be made from this strip to the 260-volt source below the chassis through a hole located to one side of the terminal strip.

SYLVANIA: HORIZ. PHASING

To counteract difficulties involving stability of the horizontal circuits, some changes are recommended for chassis 1-540-3, -4, -5, -6, and 1-537-1, -3, and -4. To improve horizontal phasing, the following changes have been made: In chassis 1-540-5 and -6, resistor R_{407-1} (2200 ohms) is changed to R_{407-1} 6800 ohms. In chassis 1-540-3 and -4, this same change is made. In addition R_{405} , 18,000 ohms, is changed to R_{405-1} , 10,000 ohms, and R_{406} , 190,000 ohms, in the a.g.c. circuit, is changed to R_{406-1} , 150,000 ohms. In the 1-537-1, -3, and -4 chassis, R_{405} , 2200 ohms, is changed to R_{405-1} , 6800 ohms.

EMERSON: COLOR H-V FAULT

Sometimes receivers in the color-TV line from models C-502A through C-507A show the development of excessive high voltage or blooming. Other related symptoms that may occur include arcing and blowing of the high-voltage fuse. When this occurs, the probable cause is a change of values in resistors of the grid circuit for the high-voltage regulator tube, 6BK4. As an example, resistor R_{100} in model C-506 may go up from 2.2 megohms to 4 megohms. The remedy is to replace the resistor with another of the same value and tolerance but with a higher wattage rating. In this case, a 1-watt unit would be used. After replacement, the high-voltage system should be adjusted as described in the service notes for the particular receiver to the correct value stated.

-30-

110° Yokes DY-26A, DY-27A Exact replacements for RCA in chassis KCS-107, 108F, 109, 113 series	Exact Replacement Flybacks for PHILCO HO-276 HO-277, HO-278 used in 171 models—with resistors and capacitors attached.	Exact Replacement for AIRLINE, FIRESTONE WELLS-GARDNER HO-273 used in 19 models
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Stereo Broadcasting
(Continued from page 65)

from 59 to 75 kc. The second sub-channel (if used) is at 42 kc. with a spread of from about 36 to 50 kc. The space from 20 to 35 kc. is left for control pulses used to operate receivers for special services. As background music is not high fidelity (usually 50 to 7500 cps), the use of one of these sub-channels might prove inadequate for the second leg of a real high-fidelity stereo program. For good stereo, the second channel ought to be as good as the main channel. Toward this end it might be possible to use the entire 20 to 75 kc. band for the second stereo channel. In the interest of conserving frequency space, the FM-Multiplex method of broadcasting stereo would seem to be a good approach.

With all the current interest in stereo some may wonder why the FM-Multiplex method is not more widely used for this purpose. The main reason for the delay is largely an economic one. When an FM station uses multiplexing for background music or storecasts, it is providing a service that can be sold directly. If the station were to use multiplexing for stereo, who would pay the bill? Of course, there are some "good music" stations which feel that by building a quality audience with good programming, both on monaural and on stereo, their advertising revenues will rise. There are some outstanding examples of successful operation with this philosophy in mind. But we will just have to wait and see whether or not other stations will embrace such "delayed benefit" altruism.

Another problem is that the FCC might not look favorably on a service that gives its listeners only half the program content, as would be the case if only one of the two stereo channels were transmitted. There are two answers to this problem. Some have pointed out that many stereo records and tapes are made with the microphones fairly close together and at a fairly great distance from the artists. In this case, it is argued, the two stereo channels are quite similar and most listeners would not find a noticeable degradation in quality if only a single channel were listened to. This begs the question of stereo however, since, if a stereo effect is to be produced, there must be differences in the two channels.

"Sum and Difference" Method

A second solution would be to use a "sum and difference" method of broadcasting stereo. In this method the two original stereo channels are added together to form a sum channel that could be broadcast over the main FM channel. This sum signal would be the equivalent of a full monaural signal with nothing removed from it. The sum signal would be received normally by the FM tuner. Then, the two orig-

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inal stereo channels are subtracted from each other at the transmitter to form a *difference* channel. This then is sent out over the sub-channel that is multiplexed on the FM carrier. The difference channel would then be handled by the multiplex adapter connected to the FM tuner. After the sum and difference signals are recovered, they are combined in such a way as to produce the two stereo channels originally picked up by the recording microphones. With this method, then, those listeners without stereo equipment could receive the entire program and not just a single stereo channel, and those with stereo equipment would be able to receive a full stereo program.

All-in-all, there are many possibilities and with stereo moving ahead at breakneck speed, we will just have to watch them all closely to see what develops.

-50-

SIMPLE XMTR. CONVERSION

By DAVID T. GEISER, W1ZEQ

MANY excellent amateur transmitter designs use 6AG7 or 6CL6 oscillators and 6146 amplifiers. Conversion of these transmitters to mobile or emergency operation with 12-volt supplies is often thought difficult because of the filament voltage difference, but can easily be done with the addition of only three parts.

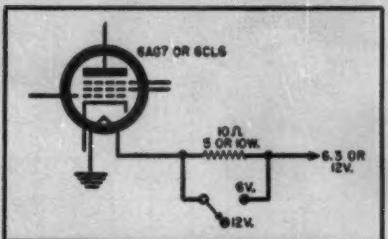
Many 6-volt tubes such as the 6V6, 6146, and most of the other octal-base tubes have directly interchangeable 12-volt equivalents. A 6146, for example, can be removed from its socket and a 6883 plugged in for 12-volt filament operation. (A 6159 is the 24-volt equivalent.)

Direct replacements for the 6AG7 and 6CL6 are not available for 12-volt service and their physical and operational characteristics would make substitution of a different type of tube a matter of circuit redesign and rewiring. These tubes lend themselves very well to the use of a stock value of series dropping resistor for 12-volt operation. A 10-ohm, 5-watt series resistor gives very satisfactory heater operation from either a 12.6-volt a.c. or d.c. filament supply. Use of a 10-watt resistor is desirable because of its cooler operation if it is to be located near other components.

Rapid change-over from 6 to 12 volts is most easily done by paralleling the dropping resistor with a s.p.s.t. toggle switch, the switch being in the closed position for 6-volt operation. Large "6 V" and "12 V" markings on the switch positions and bases of the 6146 and 6883 minimize the possibility of partial change-over and consequent damage.

-51-

Scheme for allowing 6-volt transmitters to be operated at 12-volts for mobile.



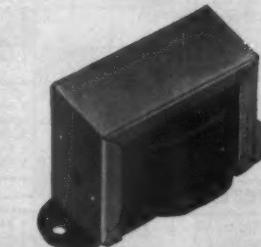
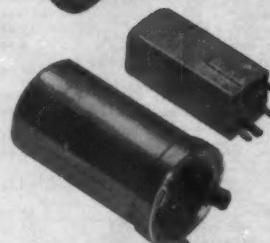
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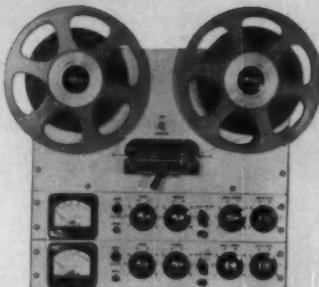
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Stereo Glossary

speakers. Although no signal is fed to the central speaker, nevertheless for some persons the visual presence of the middle speaker helps create the aural illusion of sound from the center.

38. Matching: Refers to use of speakers with identical or very similar frequency response characteristics. Speakers with unlike response—peaks and valleys at different parts of the audio spectrum—may cause the apparent source of sound to wander between left and right. Matching similarly refers to use of microphones with like frequency characteristics.

39. Cross-Talk: Undesired reproduction on one channel of audio information intended for the other channel. Occurs to a slight extent in in-line heads, where magnetic coupling causes the upper head to pick up from the lower head some of the signal which the latter has picked up from the lower track of the tape; the lower head of course picks up the upper track signal in similar fashion. Cross-talk is sufficiently low in modern stereo heads to be a negligible problem for stereo purposes, the undesired signal being 40 db down or more. However, if one half of a stereo head is also used to play back a two-track monaural tape, cross-talk may be annoying, depending upon the quality of the head. The best heads ordinarily keep cross talk to inaudible proportions. Cross-talk is of greater magnitude on stereo discs, where the undesired signal may be only 20 db down. There is a difference of views as to whether a 20 db cross-talk ratio is seriously deleterious to the stereo effect; most seem to believe it is not.

COUNTING COIL TURNS

By CARLTON A. CALDWELL

WHEN using the chuck of a hand drill to hold a coil form for winding an r.f. or other coil, where you want to count the turns, they can be counted more easily by marking a line on the chuck of the drill with a piece of white chalk.

To count the turns that you are winding onto the coil, count the number of times the chalk mark comes into view as the coil is being wound. -5-

Mark the chuck to count turns easily.



RADIO & TV NEWS

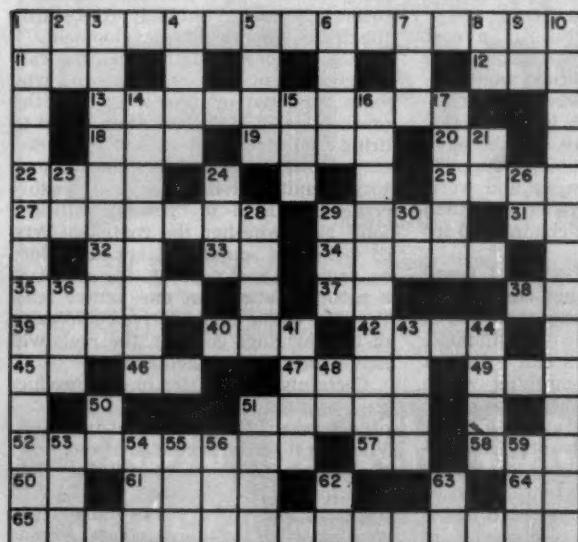
RADIO CROSSWORD

By JOHN J. GILL

HERE is a pleasant medley of technical terminology and everyday language interspersed with a couple of tricky definitions that will set you to reaching for the dictionary. If you run into any "stoppers," the answer to the puzzle can be found on page 170.

ACROSS

- Output stages.
- Eggs.
- Attempt.
- Semiconductor.
- Fox (Scot.).
- Carry (Colloq.).
- Not d.c.
- Appellation.
- Difficult sets.
- TV program rating system.
- A million (prefix).
- That is (Latin, Abbr.).
- Television transmitter (Abbr.).
- "Needle" (Abbr.).
- Pachyderm's "teeth."
- Greek letter used to designate "ohms."
- 51 (Rom. numerals).
- Small current (Abbr.).
- This, and no more.
- Tree.
- Movement of electron beam in CR tube.
- Grid voltage (Abbr.).
- Element with atomic number 10 (Abbr.).
- A medley.
- Stronghold of liberty (Abbr.).
- Not black-and-white.
- Negatively charged particle.
- Direction (Abbr.).
- Sign of the Zodiac.
- Egyptian sun god.
- Ratio of output to input voltage.
- Ham radio (Abbr.).
- Used to align FM sets.



DOWN

- Slide-wire rheostats.
- Oscillator voltage (Abbr.).
- It reads power.
- "Do you ____ me?"
- Antenna support.
- To careen.
- To and ____.
- And (Latin).
- Regenerative receiver (Abbr.).
- They divide the timing pulses from the video pulses.
- Unit of X-ray measurement.
- An atom with fewer or more electrons than normal.
- Visual viewing system.
- "Silent Sentry."
- Business group (Abbr.).
- Aspect ratio (Abbr.).
- Current opposer (Abbr.).
- American soldier.
- Some are made of quartz (Abbr.).
- Wire size.
- Don't stay!
- A million (prefix).
- "Shoot for the ____."
- Center of transformer.
- Zero point.
- 50-50 (Rom. numeral).
- Electrical engineer (Abbr.).
- Speaker diaphragm.
- Lens ____.
- Control grid voltage (Abbr.).
- To cut in on a wire.
- Ham outfit.
- Auditory organ.
- Mechanical engineer (Abbr.).
- Radio-television (Abbr.).

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A stethoscope is used in the production testing of every Acoustic Research speaker system, to detect possible air leaks in the cabinet. The speaker is driven by a twenty-cycle signal, and if there are any leaks a characteristic rushing sound can be picked up at the trouble spot.

This test procedure is necessary because the sealed-in air of an acoustic suspension enclosure is a basic working element of the speaker system. In conventional speakers the cone works against the springy stiffness of its mechanical suspensions; in AR speakers this stiffness is missing, and the cone works instead against the springiness of the enclosed air-cushion. Like the new air-suspension cars, the speaker literally rides on air.

The patented AR system requires a small cabinet, so that the unenclosed air will be springy enough. And since the air-cushion does not bind or reach its elastic limit as do mechanical springs, the AR-1 has created new industry standards in the low-distortion reproduction of music. The "bookshelf" size of AR enclosures is associated with an absolute advance rather than a compromise in speaker bass performance.

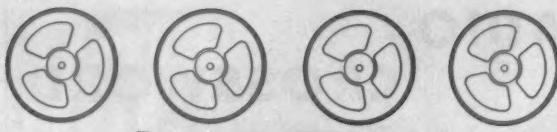
AR speakers have been adopted as reference standards, as test instruments for acoustical laboratories, and as monitors in recording and broadcast studios. Their most important application, however, has been in the natural reproduction of music for the home.

The AR-1 and AR-2, two-way speaker systems complete with enclosures, are \$185 and \$96 respectively in either mahogany or birch. Walnut or cherry is slightly higher and unfinished fir is slightly lower in price.

Literature is available on request.

ACOUSTIC RESEARCH, INC.
24 Thorndike St., Cambridge 41, Mass.

Sound on Tape



AS REPORTED in my "Record Revue" column, the stereo disc was, of course the not-altogether-unexpected sensation of the National Association of Music Merchants' Chicago exhibit. Of the many commercial "package" type manufacturers who were there, but a tiny handful exhibited any new tape equipment, or consoles incorporating tape playback equipment. One might feel that advocates of tape had a perfect right to look upon the various exhibits at the show with rather ominous forebodings. It might appear that the stereo disc was ready to sweep the stereo tape into an undeserved early grave.

However, this reporter, for one, does not feel that any such thing is either imminent or ultimate and bases these conclusions on the following: For one thing, as noted in my disc column, the quality of sound on stereo discs is extremely variable and it is perfectly honest and safe to say that, as a general rule, it left much to be desired and certainly could not be expected to compete with tape. I have always believed that the "aficionados" of stereophonic tape constitute a very quality-conscious group and I do not see these people suddenly embracing the stereo discs and abandoning something which, at present, is certainly superior. I fully expect that even when stereo discs get out of their teething stage and many of the quality problems are resolved, it will still not measure up to what the real stereo connoisseur demands.

My second point is this . . . almost hidden away in the Ampex room and in the rooms of several other tape machine manufacturers, were the first examples of the new 3.75 ips, 4-channel stereo tapes. These were, for the most part, experimental dubbings supplied mainly, I think, by Ampex and were, of course, nothing more or less than reductions of present 2-channel 7.5 ips stereo tape recordings.

The equipment upon which I heard these new tapes was what one can expect to find in the less expensive stereo systems which the stereo disc will make common in many homes and I did not hear these tapes on anything which could be construed as really top-quality hi-fi tape systems. Therefore, I might be somewhat at a disadvantage in estimating their true quality. But easily apparent was the fact that, although what I heard may not have been representative of either the best quality of

this type of tape or equipment to play it on, it was still a notable achievement.

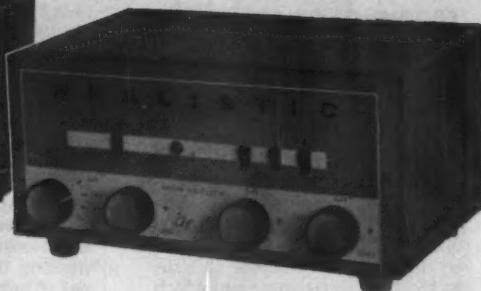
Looking to the future, I can see where 3.75 ips 4-channel tape properly recorded and with all technical resources fully exploited in its reproduction, will certainly be big competition to the stereo disc. The argument of ease of handling put forth as a particularly attractive aspect of the stereo disc does not have much weight in the face of the equally easy handling of the cartridge form of this new tape, which can be likened to magazine-loading movie cameras.

I do not pretend that I was bowled over with what I heard from the examples displayed at the show . . . I don't think there was a squeak past 5000 cycles on the high end and the bass end, while not as drastically curtailed as the treble, was nevertheless not the equal of normal 7.5 ips tape. Here, again, one must look to immediate improvement in this situation and in my opinion and in the opinions of others for whom I have a great deal of respect, a properly recorded 4-channel tape reproduced through reasonable quality home tape systems will prove a mass-selling item which rather than overshadow or undercut the stereo disc will merely augment the market. What might have been a long drawn out and comparatively slow process of introduction for this new 4-channel tape, has been considerably stimulated by many of the tape machine manufacturers who understandably are beating the drums for this new development.

RCA Victor who introduced the cartridge concept with the tape and who were supposed to have a unit on the market by NAMM show time failed to bring this forth and caused some dismay. However, Motorola showed a prototype unit and more or less brashly challenged RCA to "get on with the job." Now whether the cartridge type of 4-channel sound will appear before an ordinary reel type of this sound, is a moot question but one rather feels that due to the comparative complexity of the cartridge concept, the reels will make their appearance first.

Certainly Ampex, for one, is producing machines to play the reel type and others seem to be following suit. Whether it be the cartridge or reel type, the present Achilles heel of the problem is in duplication facilities for the 3.75 ips 4-channel tapes. These must come, in almost all instances, from Ampex

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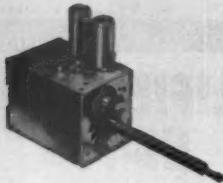
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and like many a new thing, production has been extremely slow. That the tape machine manufacturers are eager to jump into this new market, is quite obvious. Whether their combined weight will be enough to stimulate Ampex into a speed-up on delivery of the necessary dubbing equipment remains to be seen.

At any rate, although making but a tiny ripple at the show, compared to the big splash of the stereo disc, the new tape did not go unnoticed and I would look for developments in this field much earlier than anyone anticipates and, in fact, in its later stages a virtual snowballing of interests such as characterize the stereo disc.

Once again let me state unequivocally my belief that when all the fuss and fury over the stereo disc and this new 3.75 ips tape has died down, there will still be a large and active market for the standard 7.5 ips 2-channel tape. This market is likely to survive on a quality basis for a long time and if the basic cost of tape were to be reduced, making the 7.5 ips tapes more economical, I believe that the 7.5 ips tape will go on indefinitely or gradually undergo a metamorphosis into true 3-channel stereophonic tape for the ultimate in sound reproduction.

TCHAIKOWSKY

SLEEPING BEAUTY (EXCERPTS)
London Symphony Orchestra conducted by Pierre Monteux. Victor CCS-151. Price \$18.95.

Probably only the most devoted of balletomanes will shell out the rather staggering \$18.95 that is asked for this stereo tape but I can assure them that their money will be well spent. Old Monteux is a marvel. Like great vintage wine, as he ages he seems to get better and better. In these excerpts from the "Sleeping Beauty" ballet, he is at the top of his form and conducts with such virility and spellbinding vigor as to belie his years. Monteux' approach is more likely to find favor with true students of the ballet than with fanciers of outright symphonic interpretation of the score.

There is plenty of rousing brass and percussion of notable impact and the strings and woodwinds are particularly well reproduced. Directionality was somewhat less than we are used to in America, but was quite satisfactory and, if anything, this slight lack was more than offset by the superb realization of depth in the recording.

A long tape, it runs for nearly 44 minutes, this represents the sort of thing that many people would like to own but balk at the \$18.95 price and it is for these very long works that the 3.75 ips 4-channel tape should be ideal and, of course, will bring the price down to about one-third of this present tape.

As noted last month and as unfortunately I must note once again, because of all the furor about the stereo disc and also the fact that we are in the summer release doldrums, there aren't many new tapes in circulation with most of the manufacturers pulling in their horns and waiting to see what the market conditions will be. —
—

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Test for Gassy CRT's
(Continued from page 52)

To kill the video drive, remove two i.f. tubes in the i.f. strip. (One may leak enough signal to allow a picture.) In series-filament sets, a jumper from a video grid to common negative or a.g.c. bus will kill the signal.

Actually our test is simple despite the seemingly elaborate precautions required. Simply place the voltmeter leads across the grid resistor. Read the meter. If the grid is more than 1.5 volts positive, evidence against the tube is impressive.

Always make sure that the voltmeter shunts the grid resistor. Voltage generated across it alone must be metered. Fig. 2 shows the test as applied to the cathode-drive type of circuit. Fig. 3 shows the grid-drive variation. Direct-coupled circuits omit the coupling capacitor. In these latter types, position the brightness and contrast controls about the same as for normal operation or as close to it as possible.

A final word of caution is in order: before proceeding with this test, note the value of the picture-tube's grid resistor. If it is 100,000 ohms or over, proceed with the test. If it is below this value, temporarily add enough resistance in series, either by tacking on another resistor or a potentiometer, to bring the total resistance at least to the 100,000-ohm level.

This is recommended because, when resistance in the grid circuit is too low, the voltage developed across that resistance will also be low. Hence, a clear enough indication may not be obtained.

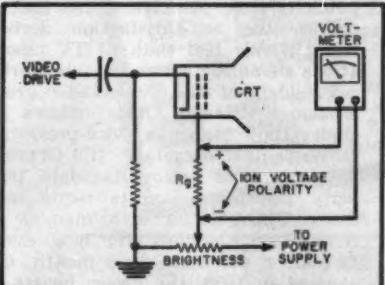
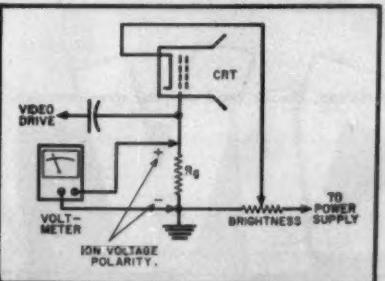


Fig. 2. The gas test set-up for a CRT whose cathode is driven by video signal.

Fig. 3. The gas test set-up for a CRT whose grid is driven with video signal.



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Service Association of the Month



TESA-RTTA OF FORT SMITH, ARKANSAS

ORIGINAL thinking is an art. The most interested and most active of us, whether we are individuals or service associations, may often miss worthwhile opportunities because we tend to take the lead from others rather than from ourselves. Doing the same things that others do, but doing them better—or at least to the best of our abilities—is something in which to take pride. Even more gratifying is discovering a new thing to do.

TESA-RTTA (Television & Electronic Service Association—Radio & Television Technicians Association) of Fort Smith, Arkansas, P. O. Box 133, Ft. Smith, Ark., like many of its contemporaries, is interested in improved technical training, business management, and standardization of service charges. Like others, it has formulated a code of ethics and is working on a licensing bill. It is also considering insurance benefits. It publishes its own organ, the "TESA-RTTA Bulletin," edited by member LeRoy Ragsdale, which appears during the second week of every month. These are all to the good, but it is in the field of public relations that the group can boast of doing a truly distinctive job.

Every association must face the problem of overcoming public distrust. It doesn't help much to realize that the attitude is born of the resentment engendered by having to buy service the public needs but wishes it could do without or something it already owns. Whatever the cause, the feeling must be dealt with. In asking themselves, "What can we do as association members to counteract this attitude?" the men in the Fort Smith group have come up with a new slant. They have reworded the question to read, "What can we do as citizens to counteract this attitude?"

Acting on behalf of their group, they have become interested in a num-

ber of civic projects in their own community. They have donated TV receivers to the local youth center and to two boys' clubs. They also provide free maintenance for these sets. A local orphanage and the Joseph M. Hill School for Cerebral Palsy have received similar benefits. In addition, TESA-RTTA members have become active, as a group, in the Fort Smith civil defense program, having equipped about 30 vehicles so that they can be converted to emergency ambulance service in minutes. Also, acting as members of their association, they have donated blood to the Red Cross. Not content with these activities, they manage to assist the Salvation Army and the Marine Reserve in the annual "Toys for Tots" campaign.

One result of these interests has been favorable publicity for the association in the local newspaper. More important, this notice merely reflects the attitude of the local citizenry. How is it possible to have any feeling but one of trust and respect toward these people? Also important is this fact: practical consideration aside, TESA-RTTA members have discovered that they are getting another, inwardly felt bonus out of their efforts. In their own words, "We feel that we get a lot of very favorable publicity from our civic duties and, of course, the self-satisfaction derived from it. We feel that all TV associations should be active in civic work."

President of this civic-minded group is James Crouch. Other officers include Tony Holzman, vice-president; O. W. Donald, secretary; Bill Gravely, treasurer; and LeRoy Ragsdale, publicity chairman. As its name indicates, TESA-RTTA is a member of NATESA. Elections are held every December, meetings every month. Organized in 1953, the group boasts 25 members.

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Service Editor

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1T4	SY3GT	GBC6	658T	12BA6	28CS
1U4	SY4G	GBC6	658T	12BA6	28W4
1U5	GAT	GBY5G	GTS	12BA6	32Z4GT
1V2	GAB	GBY5	GTS	12BA6	36
1X2	GAB4	GZ6	GUS	12BD6	37
2A3	GAC7	GZ6	GUB	12BF6	42
2A7	GAF4	GZ6	GVB	12BH7	43
2A8	GAG6	GCB5	GWA8T	12BS5	45
2A9	GAH6	GCB5	GW68T	12BV7	50AS
2A10	GAK5	GCB6	6X4	12BV7	50BS
2A11	GAL5	GCB7	6X5	12CA5	50CS
2B5	GAM5	GCL6	6X8	12D06	50GCT
2B6	GAM6	GCM6	SY6G	12DF5	50X6
2B7	GAM6	GCM7	7A4/XKL	12J5	SOY6
2B8	GAM6	GCM7	7A5	12J7	52
2B9	GAM6	GCM7	7A6	12L6	57
2B10	GAM6	GCM7	7A7	12L7	58
2B11	GAM6	GCM7	7A8	12L8	71A
2C6	GAQ5	GCU5	7A8	12L8	75
2C7	GAQ7GT	GCU6	7B4	12L8	76
2C8	GAR5	GDE6	7B5	12L8	77
2C9	GAS5	GDE6	7B6	12L8	78
2D7	GAT6	GDE6	7B7	12L8	80
2D8	GAT6	GDT6	7C4	12L8	84/624
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2D10	GAT6	GDT6	7C6	12L8	117PTGT
2D11	GAT6	GDT6	7C7	12L8	117Z3
2E4	GAU4GT	GFR	7E5	12L8	117Z6
2E5	GAU5GT	GFR	7E6	12L8	
2E6	GAU5GT	GFR	7E7	12L8	
2E7	GAU5GT	GFR	7E8	12L8	
2E8	GAU5GT	GFR	7E9	12L8	
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2E10	GAU5GT	GFR	7G7	12L8	
2E11	GAU5GT	GFR	7H7	12L8	
2F5	GAU5GT	GFR	7G7/1232	12L8	
2F6	GAU5GT	GFR	7H7	12L8	
2F7	GAU5GT	GFR	7H7	12L8	
2F8	GAU5GT	GFR	7H7	12L8	
2F9	GAU5GT	GFR	7H7	12L8	
2F10	GAU5GT	GFR	7H7	12L8	
2F11	GAU5GT	GFR	7H7	12L8	
2G4	GAU5GT	GFR	7H7	12L8	
2G5	GAU5GT	GFR	7H7	12L8	
2G6	GAU5GT	GFR	7H7	12L8	
2G7	GAU5GT	GFR	7H7	12L8	
2G8	GAU5GT	GFR	7H7	12L8	
2G9	GAU5GT	GFR	7H7	12L8	
2G10	GAU5GT	GFR	7H7	12L8	
2G11	GAU5GT	GFR	7H7	12L8	
2H4	GAU5GT	GFR	7H7	12L8	
2H5	GAU5GT	GFR	7H7	12L8	
2H6	GAU5GT	GFR	7H7	12L8	
2H7	GAU5GT	GFR	7H7	12L8	
2H8	GAU5GT	GFR	7H7	12L8	
2H9	GAU5GT	GFR	7H7	12L8	
2H10	GAU5GT	GFR	7H7	12L8	
2H11	GAU5GT	GFR	7H7	12L8	
2I4	GAU5GT	GFR	7H7	12L8	
2I5	GAU5GT	GFR	7H7	12L8	
2I6	GAU5GT	GFR	7H7	12L8	
2I7	GAU5GT	GFR	7H7	12L8	
2I8	GAU5GT	GFR	7H7	12L8	
2I9	GAU5GT	GFR	7H7	12L8	
2I10	GAU5GT	GFR	7H7	12L8	
2I11	GAU5GT	GFR	7H7	12L8	
2J4	GAU5GT	GFR	7H7	12L8	
2J5	GAU5GT	GFR	7H7	12L8	
2J6	GAU5GT	GFR	7H7	12L8	
2J7	GAU5GT	GFR	7H7	12L8	
2J8	GAU5GT	GFR	7H7	12L8	
2J9	GAU5GT	GFR	7H7	12L8	
2J10	GAU5GT	GFR	7H7	12L8	
2J11	GAU5GT	GFR	7H7	12L8	
2K4	GAU5GT	GFR	7H7	12L8	
2K5	GAU5GT	GFR	7H7	12L8	
2K6	GAU5GT	GFR	7H7	12L8	
2K7	GAU5GT	GFR	7H7	12L8	
2K8	GAU5GT	GFR	7H7	12L8	
2K9	GAU5GT	GFR	7H7	12L8	
2K10	GAU5GT	GFR	7H7	12L8	
2K11	GAU5GT	GFR	7H7	12L8	
2L4	GAU5GT	GFR	7H7	12L8	
2L5	GAU5GT	GFR	7H7	12L8	
2L6	GAU5GT	GFR	7H7	12L8	
2L7	GAU5GT	GFR	7H7	12L8	
2L8	GAU5GT	GFR	7H7	12L8	
2L9	GAU5GT	GFR	7H7	12L8	
2L10	GAU5GT	GFR	7H7	12L8	
2L11	GAU5GT	GFR	7H7	12L8	
2M4	GAU5GT	GFR	7H7	12L8	
2M5	GAU5GT	GFR	7H7	12L8	
2M6	GAU5GT	GFR	7H7	12L8	
2M7	GAU5GT	GFR	7H7	12L8	
2M8	GAU5GT	GFR	7H7	12L8	
2M9	GAU5GT	GFR	7H7	12L8	
2M10	GAU5GT	GFR	7H7	12L8	
2M11	GAU5GT	GFR	7H7	12L8	
2N4	GAU5GT	GFR	7H7	12L8	
2N5	GAU5GT	GFR	7H7	12L8	
2N6	GAU5GT	GFR	7H7	12L8	
2N7	GAU5GT	GFR	7H7	12L8	
2N8	GAU5GT	GFR	7H7	12L8	
2N9	GAU5GT	GFR	7H7	12L8	
2N10	GAU5GT	GFR	7H7	12L8	
2N11	GAU5GT	GFR	7H7	12L8	
2O4	GAU5GT	GFR	7H7	12L8	
2O5	GAU5GT	GFR	7H7	12L8	
2O6	GAU5GT	GFR	7H7	12L8	
2O7	GAU5GT	GFR	7H7	12L8	
2O8	GAU5GT	GFR	7H7	12L8	
2O9	GAU5GT	GFR	7H7	12L8	
2O10	GAU5GT	GFR	7H7	12L8	
2O11	GAU5GT	GFR	7H7	12L8	
2P4	GAU5GT	GFR	7H7	12L8	
2P5	GAU5GT	GFR	7H7	12L8	
2P6	GAU5GT	GFR	7H7	12L8	
2P7	GAU5GT	GFR	7H7	12L8	
2P8	GAU5GT	GFR	7H7	12L8	
2P9	GAU5GT	GFR	7H7	12L8	
2P10	GAU5GT	GFR	7H7	12L8	
2P11	GAU5GT	GFR	7H7	12L8	
2Q4	GAU5GT	GFR	7H7	12L8	
2Q5	GAU5GT	GFR	7H7	12L8	
2Q6	GAU5GT	GFR	7H7	12L8	
2Q7	GAU5GT	GFR	7H7	12L8	
2Q8	GAU5GT	GFR	7H7	12L8	
2Q9	GAU5GT	GFR	7H7	12L8	
2Q10	GAU5GT	GFR	7H7	12L8	
2Q11	GAU5GT	GFR	7H7	12L8	
2R4	GAU5GT	GFR	7H7	12L8	
2R5	GAU5GT	GFR	7H7	12L8	
2R6	GAU5GT	GFR	7H7	12L8	
2R7	GAU5GT	GFR	7H7	12L8	
2R8	GAU5GT	GFR	7H7	12L8	
2R9	GAU5GT	GFR	7H7	12L8	
2R10	GAU5GT	GFR	7H7	12L8	
2R11	GAU5GT	GFR	7H7	12L8	
2S4	GAU5GT	GFR	7H7	12L8	
2S5	GAU5GT	GFR	7H7	12L8	
2S6	GAU5GT	GFR	7H7	12L8	
2S7	GAU5GT	GFR	7H7	12L8	
2S8	GAU5GT	GFR	7H7	12L8	
2S9	GAU5GT	GFR	7H7	12L8	
2S10	GAU5GT	GFR	7H7	12L8	
2S11	GAU5GT	GFR	7H7	12L8	
2T4	GAU5GT	GFR	7H7	12L8	
2T5	GAU5GT	GFR	7H7	12L8	
2T6	GAU5GT	GFR	7H7	12L8	
2T7	GAU5GT	GFR	7H7	12L8	
2T8	GAU5GT	GFR	7H7	12L8	
2T9	GAU5GT	GFR	7H7	12L8	
2T10	GAU5GT	GFR	7H7	12L8	
2T11	GAU5GT	GFR	7H7	12L8	
2U4	GAU5GT	GFR	7H7	12L8	
2U5	GAU5GT	GFR	7H7	12L8	
2U6	GAU5GT	GFR	7H7	12L8	
2U7	GAU5GT	GFR	7H7	12L8	
2U8	GAU5GT	GFR	7H7	12L8	
2U9	GAU5GT	GFR	7H7	12L8	
2U10	GAU5GT	GFR	7H7	12L8	
2U11	GAU5GT	GFR	7H7	12L8	
2V4	GAU5GT	GFR	7H7	12L8	
2V5	GAU5GT	GFR	7H7	12L8	
2V6	GAU5GT	GFR	7H7	12L8	
2V7	GAU5GT	GFR	7H7	12L8	
2V8	GAU5GT	GFR	7H7	12L8	
2V9	GAU5GT	GFR	7H7	12L8	
2V10	GAU5GT	GFR	7H7	12L8	
2V11	GAU5GT	GFR	7H7	12L8	
2W4	GAU5GT	GFR	7H7	12L8	
2W5	GAU5GT	GFR	7H7	12L8	
2W6	GAU5GT	GFR	7H7	12L8	
2W7	GAU5GT	GFR	7H7	12L8	
2W8	GAU5GT	GFR	7H7	12L8	
2W9	GAU5GT	GFR	7H7	12L8	
2W10	GAU5GT	GFR	7H7	12L8	
2W11	GAU5GT	GFR	7H7	12L8	
2X4	GAU5GT	GFR	7H7	12L8	
2X5	GAU5GT	GFR	7H7	12L8	
2X6	GAU5GT	GFR	7H7	12L8	
2X7	GAU5GT	GFR	7H7	12L8	
2X8	GAU5GT	GFR	7H7	12L8	
2X9	GAU5GT	GFR	7H7	12L8	
2X10	GAU5GT	GFR	7H7	12L8	
2X11	GAU5GT	GFR	7H7	12L8	
2Y4	GAU5GT	GFR	7H7	12L8	
2Y5	GAU5GT	GFR	7H7	12L8	
2Y6	GAU5GT	GFR	7H7	12L8	
2Y7	GAU5GT	GFR	7H7	12L8	
2Y8	GAU5GT	GFR	7H7	12L8	
2Y9	GAU5GT	GFR	7H7	12L8	
2Y10	GAU5GT	GFR	7H7	12L8	
2Y11	GAU5GT	GFR	7H7	12L8	
2Z4	GAU5GT	GFR	7H7	12L8	
2Z5	GAU5GT	GFR	7H7	12L8	
2Z6	GAU5GT	GFR	7H7	12L8	
2Z7	GAU5GT	GFR	7H7	12L8	
2Z8	GAU5GT	GFR	7H7	12L8	
2Z9	GAU5GT	GFR	7H7	12L8	
2Z10	GAU5GT	GFR	7H7	12L8	
2Z11	GAU5GT	GFR	7H7	12L8	

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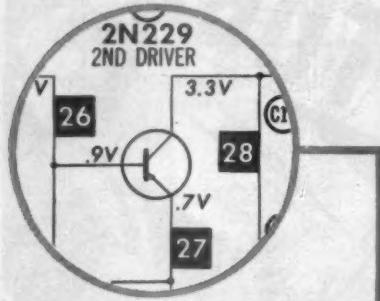
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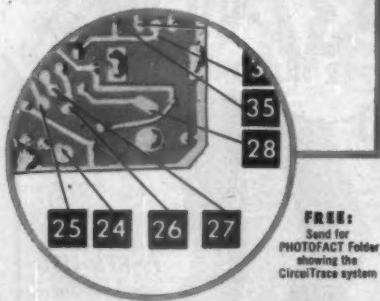
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Mobile System
(Continued from page 56)

form can be de-magnetized if it is suspended by a string into the field of a medium power final amplifier coil for a few moments and then withdrawn while the power is still on. It should be pointed out that many soldering guns put out a strong enough field to magnetize one of these cores, so they should be approached with caution.

When alignment and tracking adjustments have been completed, the final amplifier plate circuit can be tuned up. This is a low-“Q” circuit because of the antenna radiation and will not show much of a dip in the plate current as the circuit is tuned through resonance. On the 10-meter band, resonance should occur with about 10 μ sf. of tuning capacitance if the coil has been properly made. In general, the more capacitance required to resonate the “L” network, the heavier will be the loading.

The adjustment of the loading of an “L” network is somewhat tricky, but the circuit gives excellent bandwidth in this application and is well worth the extra effort.

The characteristic impedance of the quarter-wavelength transformer feeding the antenna is a major factor in controlling the final amplifier loading. A tube requiring a relatively low impedance plate load, such as the two sections of the type 829 in parallel, calls for two 50-ohm transformer sections in parallel, while the single 1625 tube used by the author needs three. Intermediate values can be obtained by combinations of 50- and 75-ohm cable. If the 90-ohm cables, such as RG-71/U, are considered, it must be remembered that they do not use a solid dielectric filler and therefore do not have the same velocity of propagation as the lower impedance cables. This means that while an electrical quarter-wavelength in 50- or 75-ohm cable will be approximately 5' 4", a quarter-wavelength in the 90-ohm cables will be about 6' 9", so be sure of your cables.

After the final amplifier has been tuned, the parallel trimmer capacitor, C_{26} , can be adjusted to minimize second harmonic transmission which will come in on Channel 2 of the family TV. Then a re-touch of the final tuning capacitor and the tune-up is completed.

Design Variations

Practically nobody ever wants to build anything as a “Chinese copy” complete to the last screw, so this section is included to give the experimentally minded individual something to work on.

Consideration of the frequencies used in the receiver's frequency conversions will show that the system can easily be changed to 20-meter operation by re-designing the r.f. and first mixer grid circuits in the converter and re-setting the frequency limits of the tuned local oscillator. Modifica-

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RADIO & TV NEWS

tions to the transmitter section would require re-tuning the plate circuits of the mixer, buffer, and final amplifier to the 20-meter band.

If exclusive operation on the 20-meter band is considered, the reduced tuning range allows simplification of the design. Gang tuning of the r.f. and mixer grid circuits in the converter, for example, would no longer be necessary. These circuits could be peaked near the center of the band and then left. A single-section tuning capacitor would therefore suffice and it would become convenient to construct the converter and the transmitter as a single unit to be mounted in the trunk of the car. At the driver's position, all that would be required would be the remote tuning unit of the local oscillator, consisting of the toroid coil, the tuning capacitor, and appropriate trimming and padding capacitors. Also required would be an "off-on" switch for the system and a jack for the microphone.

Because of the two-band possibilities, a bandswitching system should be possible, where the lower frequency band is reached by throwing additional capacitance across the tuned circuits. Switching in this way should not affect the tracking ability of the system and offers a most interesting field for further development.

Results

The frequency stability of the toroid coil oscillator is good enough to permit reception of 10-meter SSB signals while riding over rough roads. The necessary b.f.o. was provided by a 190 to 550 kc. ARC-5 receiver which replaced the car radio receiver. The usual skip contacts are made whenever QRM and propagation conditions permit. A contact was made with London on a Sunday afternoon but this is, of course, exceptional for any mobile rig. Operating this rig has left the writer with the feeling that if you can hear them, you can work them.

In conclusion, the effort involved in designing and building this mobile system has proven worthwhile. Mobile operation becomes a real pleasure when the transmitter is always on frequency, ready to answer a "CQ", or to break in on an established contact, for a round-table discussion.

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By MORRIS DORSEY

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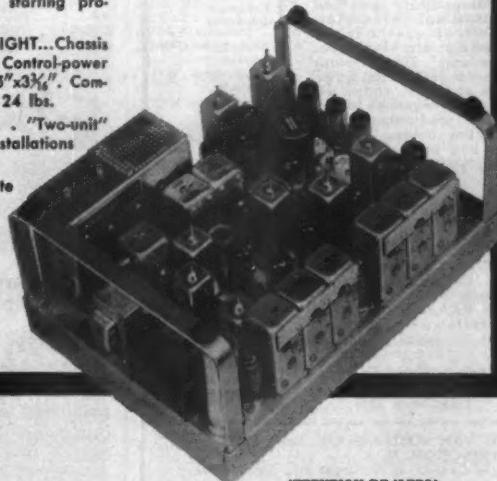
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"SCOTCHMAN" DATA

Winegard Company, 3000 Scotten Road, Burlington, Iowa is currently offering two illustrated catalogue sheets which describe the outstanding features of its "Scotchman" TV antenna and supply complete details on the firm's stamp premium offer for technicians.

The "Scotchman" all-channel antenna series consists of four basic models and four attachment kits that can be combined to produce more than 30 antenna combinations. The kits allow the service technician to increase the gain and/or front-to-back ratio of each antenna to meet any reception requirements.

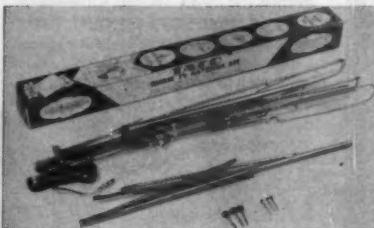
The stamps for dealers are enclosed in each antenna carton. They are redeemable for nationally advertised tool sets or more antennas.

Copies of these illustrated catalogue sheets with full information on the premium offer and the antennas covered by the offer are available without charge upon written request to the manufacturer.

"QUIKIE" ANTENNA KITS

Technical Appliance Corporation of Sherburne, N. Y. has recently introduced the first of a series of "Quikie" antenna kits which have been designed and field tested to insure high performance and durability.

The new kits comprise a complete package with the antenna factory-assembled to the mast. The set termi-



nations are made by means of a unique clip which requires no tools to attach.

The antenna has a gold anodized finish which is nickel-sealed to the metal for permanence. The kit is packaged in an eye-catching display box which serves as a "point-of-sale" carton and promotion piece.

"DURA-GOLD CORVETTE"

Clear Beam Antenna Corporation of Canoga Park, California has released its Model CV90 deep fringe antenna as the "Dura-Gold Corvette."

Designed to provide sharp all-channel fringe reception at moderate cost, the antenna incorporates several unique engineering principles includ-

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ing dual side-by-side directors on the high band, a cancellation method of wave reversal, and separate delta matching harnesses for both the high and low band.

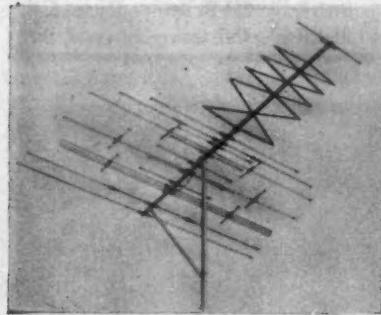
The construction is entirely snap-out with no nuts or bolts used throughout the antenna. Elements are of aircraft type aluminum protected with a "Dura-Gold" finish. All clamps are of cad-plated steel construction. With a boom length of 83 inches, the antenna functions on all v.h.f. channels and receives both black-and-white and color transmissions.

28-ELEMENT TV ANTENNA

JFD Electronics Corporation, 6101 16th Ave., Brooklyn 4, N.Y. has announced the availability of a 28-element television antenna for all-band reception of both black-and-white and color signals.

Named the "Satellite-Helix," the new antenna features a balanced sleeve dipole system which electrically enlarges its capture area for as much as 35% greater gain on all channels. New spatial relationship of parasitic and collector elements achieves up to a 15:1 (low band) and 18:1 (high band) front-to-back voltage ratio, according to the manufacturer.

The antenna incorporates multiple driver dipoles for sharper directivity



and decreased ghost and reflective pickup. Mechanically, the unit is boom-braced for added rigidity and features six $\frac{1}{2}$ " seamless elements. All elements measuring over 30" are reinforced by 15" aluminum dowels. Insulators are made of low-loss weather-proof "Kralastic B."

ANTENNA FLIERS

Channel Master Corp. of Ellenville, N.Y. has published five pieces of literature for TV antenna installers. They are available free upon request.

A 4-page, 2-color folder describes the approach in rotator circuit design utilized by the "Tenn-A-Liner." Two of the fliers describe the "Sky-Blazer" antenna and the "Color Prince." A third brochure tells how the u.h.f. "Parascope" utilizes the parabolic principle.

In addition there is a piece entitled, "Wanted For Murder: 'Salty' Waters," dealing with TV antenna installation problems created by salt air, salt water, and rain, particularly in coastal areas.

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1L4	.45	6AU6	.52	6T8	.90	12XA	.45
1LC5	.49	6AV6	.44	6USA	.85	14A7/12B7	.81
1LC6	.46	6AW8A	.88	6V6GT	.53	14AF7	.88
1LH4	.60	6AX4GT	.66	6W4GT	.65	14B6	.76
1LN5	.46	6BAS	.50	6W6GT	.76	14Q7	.96
1NSGT	.48	6BA7	.92	6X4	.46	17AX4GT	.72
1R5	.63	6BAA	.91	6X5	.56	19AU4GTA	.92
1S4	.77	6BC5	.57	6X8	.85	19	.25
1S5	.60	6BD6	.57	7AU7	.69	25AX4GT	.75
1T4	.60	6BE6	.55	7C4	.65	25BR5	.75
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3CB6	.58	6C5	.72	12AV6	.46	35B5	.66
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3DT6	.54	6C8	.55	12AX7	.68	35W4	.39
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4BC8	1.03	6CG7	.61	12BA6	.55	35Y4	.66
4BN6	.75	6CG8A	.80	12BA7	.85	35Z3	.66
4BQ7A	1.01	6CM7	.69	12BD5	.56	35Z5GT	.49
4BC5	.58	6C56	.57	12BE6	.57	36	.25
4BU8	.71	6CU6	.99	12BF6	.49	39/44	.25
4BZ7	1.03	6D6	.92	12BH7A	.77	41	.77
4CB6	.56	6DR5	.69	12BK5A	.91	42	.75
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5AN8	.90	6DQ6A	.99	12BQ6GT	1.19	45Z3	.30
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5CG6	.81	6FG7	.71	12C5/12CU5	.56	50LG7	.65
5J6	.71	6GG6	.99	12CX6	.56	50A6	.88
5U4C8	.55	6H6	.70	12DK7	.81	50Y6GT	.79
SUS	.84	6JS	.65	12DQ6A	1.11	57	.49
SV3	.90	6J6	.75	12EM6	.75	75	.95
SY3GT	.39	6J7	.90	12F5	.75	78	.95
SY4GT	.64	6KG7	.52	12K80T	.69	80	.60
SAT	1.01	6K7	.90	12K76T	.85	83	.85
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Behind Stereo Scene

(Continued from page 43)

coded stereo system discussed in August, 1956 and June, 1957 issues of this magazine. In view of developments in other directions, it was felt that persistence with this coded idea would only add to the "confusion." But many readers evinced great enthusiasm for it as a "do-it-yourself" system of stereo—and they are not to be readily disuaded.

We are unwilling to predict any real future for coded stereo, but a number of hard-core enthusiasts will undoubtedly continue to derive enjoyment from playing with it. Two-channel stereo is one thing (whether 45-45, *Minter*, or one of the tapes), pseudo stereo (or semi-stereo, where a single channel is "operated on" by suitable "electronics" to achieve an effect) is another; coded stereo is yet another—it gives a person with creative instinct some pride in having contributed to the esthetic effect.

What about the future for tape? Will the new tape cartridges help tape to steal the disc market?

This is another question that draws divergent answers. Tape has appealed to its users for three main reasons: uninterrupted playing time; quality; and the ability to record as well as play. "Against" it has been cost and inconvenience in use as compared with disc. This is why there have been two parallel, rather than competitive, markets.

The tape cartridge makes playing time about the same as disc. Quality is anybody's guess right now. People responsible for developing the *system* claim improvements in technique have made the 3.75 ips speed, narrower track tapes equal to previous material on the 7.5 ips two-track tapes. The obvious thing here is that if, for economy purposes, this improvement can be made on 3.75 ips tapes, the 7.5 ips two-track tapes could be made *that much better*, which is true.

But right now this claim is rather difficult to prove, because early material recorded in this medium does not have a high end equal to earlier 7.5 ips tape and what has been audited thus far does not have equal dynamic range either—anywhere near.

It still has the ability to record as well as play.

However, the cost and convenience questions are still compromised—they have not yet provided the way to put tape "on a level" with disc. The ceramic cartridge makes the inexpensive disc player possible; but tape will continue to require a high-gain preamplifier for each channel, cartridge packaging or no cartridge packaging.

The convenience does not as yet equal disc. True—when it is perfected (we hope)—putting on the cartridge will be as easy as mailing a letter. But it is not as easy to pick out your favorite passage at a moment's notice and

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RADIO & TV NEWS

we don't see how it ever can be done. Taken all-in-all, we doubt whether the advent of the cartridge will materially alter the distribution of the market between tape and disc. The relative appeal of the two is only slightly modified. They will continue as parallel, rather than competitive, markets.

The four-track tape, as used in the tape cartridge, may well be adapted for use in regular reel-handling machines because of the much greater playing time on a given amount of tape, if the improvement in quality is really there. But two-track 7.5 ips tape will stay for a long while yet, because it offers much better quality than four-track tapes recorded at 3.75 ips.

The advent of a cheap tape player may extend the cartridge tape market, but don't expect a tape equivalent of the 45 rpm disc changer—it won't be that cheap.

What would you advise me to do now about getting started in stereo? Should I wait or buy now?

Take your pick and buy now. The manufacturers are just as concerned about obsolescence as you are. Whatever you buy (or already have) will not be rendered obsolete by newer developments. If you have a tape recorder, tapes will continue to be made available at the speed your machine operates. Probably, too, conversion kits will bring you up-to-date with new developments.

If you go for the new stereo on disc, whatever changes in recording technique may be introduced to get better quality in various directions will not "junk" what you have. You will still be able to play the improved records with the cartridge you buy now; and a replacement cartridge will probably make them sound even better when the time comes.

The potential for future development mentioned at the beginning of this article is *on the consumer's side*. The manufacturer will have to pay for it. The consumer will get the benefit with a minimum—if any—extra outlay.

—50—



October, 1958



BY *Grommes*

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Manufacturers' Literature

SEMICONDUCTOR USES

The Semiconductor Division, Hoffman Electronics Corporation, 930 Pittner Ave., Evanston, Ill. has just issued the first in a new series of semiconductor application bulletins, "The Use of Silicon Junction Diodes to Protect Sensitive Current Devices."

The application notes illustrate how the non-linear characteristics of silicon diodes in both the forward and Zener operating regions make them ideally suited to the protection of d.c. and a.c. measuring instruments.

The applications presented include: d.c. microammeter protection, d.c. voltmeter protection, protection of microwatt relays and low-current meter-type relays, a.c. milliammeter protection, and a.c. voltmeter protection.

Copies of this bulletin are available from the company without charge. Please address your requests to Bulletin Editor in care of the firm.

HEATHKIT FLYER

Heath Company, Benton Harbor, Mich. has made available a new flyer complete with order blanks.

The brochure covers the firm's complete line of kits, including test equipment and high-fidelity components. In addition, there is also a list of the company's franchised dealers. This new policy enables the customer to purchase equipment from local dealers as well as through mail orders.

TRANSISTOR CIRCUIT BOOKLET

A new booklet, "Performance Tested Transistor Circuits" has been announced by Sylvania Electric Products Inc.

Designed primarily for hobbyists and students of electronics, the 60-page booklet contains a variety of circuits plus information on how to build transistorized hi-fi components, test equipment, photography light meters, and special equipment such as burglar alarms and organ metronomes.

In addition to a section on elementary transistor theory, the brochure contains 36 circuit descriptions, complete with schematics and parts lists.

Copies may be obtained for 35¢ per booklet from the firm at 1100 Main St., Buffalo 9, N. Y.

NEW "MAGNEFORMER" LITERATURE

Perma-Power Company, 3100 N. Elston Ave., Chicago 18, Ill. has published a new multi-color catalogue sheet on its "Magneformer," a specially developed device for magnetizing or demagnetizing screwdrivers, nut runners, hammers, pliers, small wrenches, probes, tweezers, special instruments,

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Write direct to the company requesting Catalogue B-139.

MOTEL TV BOOKLET

Blonder-Tongue Laboratories, Inc., 9 Alling St., Newark 2, N. J. is making available its new 4-page booklet, "Upgrade Your Motel."

Designed to give dealers and installers a selling tool for use in the motel market, the booklet shows one of the firm's master antenna systems in a simplified block diagram, and features lower cost, longer life, better motel appearance, and improved TV reception as the motel owners' greatest concern.

This presentation is attractively illustrated in 2-color reproduction and includes several picture stories of successful TV systems which have appeared in motel trade media.

Copies of the brochure may be obtained directly from the company or through its authorized distributors.

1959 G-C CATALOGUE

The General Cement Mfg. Co. catalogue for 1959 is now available listing hundreds of new developments for the electronic industry. New aids in electronic chemicals, hardware, switches, and service tools are featured among the 80 pages of products for the radio, television, and electronic industry.

The catalogue is sectionalized for easy reference to specific categories such as alignment tools, service aids, speaker kits, test leads, switches, etc.

For a free copy of catalogue No. 158, see your local electronic parts distributor or write direct to the company at 400 South Wyman St., Rockford, Ill.

TRANSFORMER REPLACEMENT GUIDE

A 16-page "Stancor" publication, devoted exclusively to auto radio transformer replacement information, has been published by Chicago Standard Transformer Corp., 3501 Addison St., Chicago, Ill.

This service reference lists replacements for over 400 models of 37 manufacturers, including a special section on transistorized auto radios. They are listed by auto and radio manufacturer, as well as by year of use. Transformer replacement data for vibrator, audio, driver, and interstage transformers is given for all models listed.

The guide is available without charge from the firm's distributors or by writing directly to the company.

TV PICTURE TUBES

A new booklet, "There's a Big Difference in Television Picture Tubes," has been issued by Sylvania Electric Products, Inc.

The 16-page illustrated brochure describes precision manufacturing material and techniques that contribute to the life and performance of quality picture tubes. Topics covered include the choice of a tube to obtain pictures of the same high quality as those transmitted by a brand-new TV receiver and the differences between a cut-rate off-brand tube and a name-brand component.

Copies of this booklet may be obtained from the company, 1100 Main Street, Buffalo 9, N. Y.

MERIT HANDBOOK

Merit Coil & Transformer Corporation's new Service Technicians' Handbook is now available through its distributors.

The book lists the firm's replacements for the products of 135 television, radio, and electronics manufacturers. It is a condensed 60-page 8½" x 11" version of the complete catalogue for ready reference by technicians, with replacement numbers and list prices.

ARGONNE CATALOGUE

Argonne Electronics Mfg. Corp., 165-11 South Rd., Jamaica 33, N. Y. has announced a new catalogue, number ASC-300.

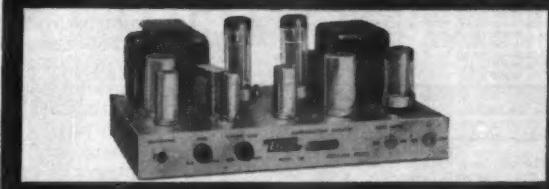
The brochure features two of the company's new units, the AR-660 multimeter and the AR-230 power megaphone. This catalogue includes, in addition to illustrations of

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8 MFD	600 VDC	1.00	4 MFD	3000 VDC	6.95
10 MFD	600 VDC	1.10	4 MFD	3500 VDC	7.95
12 MFD	600 VDC	1.50	1 MFD	7500 VDC	6.95
12 MFD	1000 VDC	1.50	1 MFD	7500 VDC	9.95
12 MFD	1000 VDC	.85	1 MFD	15,000	24.95
10 MFD	1000 VDC	.85	1 MFD	25,000	34.95
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11 MFD	1200 VDC	.45	10 MFD	600 AC	1.95
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12 Volt DPST Advance Relay \$1.35
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General Telephone Relay, 220V. 60 cyc. 45 sec. adj. 2 pole DT. \$6.95
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0-100

"Collective Security"
(Continued from page 60)

From a business standpoint, the dealer will find his association membership invaluable in many ways. The steady growth of electronic products is opening up numerous new fields of opportunity for service dealers. Most of these new opportunities are not widely publicized. Many industrial and commercial installations of electronic or electronically controlled products are made without publicity or fanfare. Yet in many cases, these installations offer new sources of business for the service dealer who is interested in handling them. An association with an alert membership will keep its finger on new developments in its area so that interested members can take advantage of the opportunities that appeal to them.

How to promote new business poses serious problems to most dealers. With only limited resources available, the dealer must make every dollar he spends for advertising and promotion pay off. He does not have enough money to experiment, so he is inclined to use a hit-or-miss method in selecting his promotions.

In an association, dealers are able to benefit from their combined experiences with various kinds of promotions. As an example, in one newly formed association the members were all concerned with the problem of promoting their businesses effectively and economically. One dealer showed them how he used handbills, distributed by high-school students, in selected areas near his shop. The results he got from this promotion were quite impressive. Five other members of the association adopted his plan. They all found it to be the best type of promotion they had ever used. The pooling of experiences like that have been valuable to dealers who take an active part in their association meetings.

Finally, we come to the important problem of better public relations for the independent service industry as a whole. There is very little any one individual can do by himself to build public respect for his activity. He can, of course, build respect for his individual business by maintaining good customer relations. However, to be continuously successful, his business must have a steady stream of new customers flowing into it. If the public continues to regard the members of the independent service industry as a bunch of blackguards, the flow of business into all independent service shops will gradually decrease.

It is only through the collective efforts of all ethical dealers, working together in associations, that consumer respect for independent TV service shops can be earned. In short, association membership is the only long-range, business-insurance policy which an electronic service dealer can buy.

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Ziff-Davis Publishing Co., 434 S. Wabash Ave., Chicago 5, Ill.

Stereo Disc Conversion

(Continued from page 44)

changing over to a magnetic type head.

Existing equipment may influence cartridge choice in another way. The electronic portion of a modest system may use an a.c.-d.c. type of power supply, eschewing the power transformer. If a comparable unit is added for the second channel, grounding problems arise. Although the two chassis may be independently plugged into the power line, an inadvertent connection between them can be made through the phono pickup leads. Many stereo cartridges use three leads, with one of them common to both channels. A hot chassis in one channel could therefore be connected directly to its opposite number, which may be at earth ground. The specters of fuse blowing and equipment damage then loom.

One way to duck the problem is to use a cartridge with four leads, two for each channel. This flexibility may also assist in minimizing induced hum and ground loops. However, care must also be observed to avoid confusing the wires. For example, improper phasing of the two channels with respect to each other could damage the stereo effect. If a 3-terminal cartridge is chosen for a transformerless system, there is another way to avoid trouble. The power cords to the two chassis can be strapped together so that they terminate in a single plug, care being taken that the negative or ground side of each chassis is strapped to the same lead of the joined power cord. This guards against the possibility of plugging one unit in the wrong way with respect to its opposite number.

Another problem involving cartridge leads is an old one that needs special attention. The twisting of leads is important to avoid hum, especially with high-level pickups. Where there are two shielded leads, they should be insulated from each other to avoid contact between the outer shields at any point along their length. With 3-terminal cartridges, both shields must be grounded together at one connection of the cartridge, but 4-terminal units should be grounded only through the automatic internal connections to the preamplifier(s).

Cartridge lead lengths are also important. It is usually advisable to keep them short, of course. In addition, they should be of the same length for each channel. If the phono-input leads to one preamplifier are longer than those to the other preamp or amplifier, which may be separately located, there is a chance of adversely affecting the stereo illusion by throwing the channels out of balance. Signal-level and frequency-response losses may not be the same for both channels.

Another noise problem: many record changers use a muting switch to short out the cartridge during the change cycle, thus eliminating reproduction of annoying clicks and thumps for that

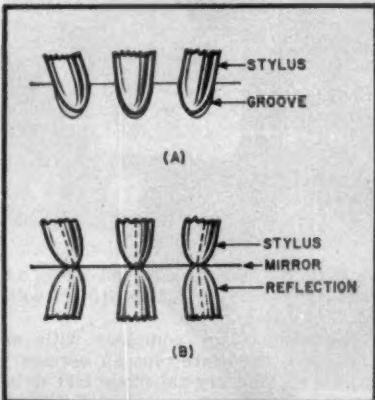
period. While these effects may turn out to be exceptionally annoying in three dimensions, conventional changers are only equipped to mute a pair of leads for a single channel. Some changer manufacturers are considering making available for their earlier changers a strip to be added to the muting switch to achieve 2-channel muting. Sometimes a strip with the added contact can be improvised.

On the other hand, it may not even be necessary to become concerned over the problem of muting. Some experts point out that, whatever noise may occur during the change cycle, it does not take place while desired information is being transmitted. Since only the noise that occurs during the play period has bearing on the stereo illusion, these people feel that the question of 2-channel muting can be ignored entirely.

One of the most important problems exists at the very beginning of the stereo-disc chain, with respect to the stylus. While stylus-to-groove alignment is always important, it can make the difference, with a 2-channel system, between getting good stereo and none at all. The cartridge essentially consists of two sensing devices, responding differently to the motion of the single stylus. While both sidewalls of the grooves in a monaural disc contain the same information, the difference in signal between opposing sidewalls in the stereo groove is what makes two channels possible.

To obtain the desired effect, good vertical alignment of the stylus, shown in the center of Fig. 1A, is mandatory. Extreme misalignment, shown to the left and right in this illustration, could result in serious loss of essential information. For this reason, a final check at the completion of every conversion is of utmost importance. This can be accomplished by laying a small mirror flat on the turntable, in place of the record, and bringing the stylus to rest on it. As shown in Fig. 1B, comparison of the stylus itself against its own reflected image highlights any misalignment. The stylus should be exactly in line with its reflection, as seen in the mirror.

Fig. 1. Vertical alignment of the stylus (A) is important to the stereo illusion. Check this with a mirror (B).



October, 1958



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What's New in Radio



HIGH-IMPEDANCE V.T.V.M.

Simpson Electric Company, 5200-18 W. Kinzie St., Chicago 44, Ill. has introduced a new vacuum-tube voltmeter which has an input impedance of 22 megohms in addition to other advanced features.

Known as the Model 311, the instrument comes complete with a d.c.-a.c. ohms probe with "Timesaver Tip," provides peak-to-peak readings of complex a.c. voltages as well as sine waves, peak-to-peak and r.m.s. values readable on the same scale, and 3% accuracy on the low d.c. voltage scale.



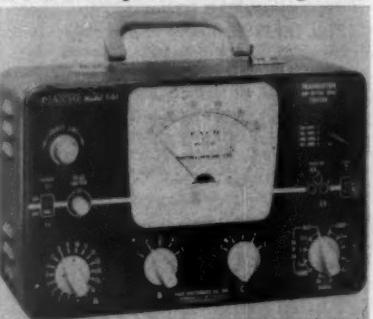
The meter is a 4½" "Wide-Vue" type. The tester case is metal and measures 7½" x 5¾" x 4½". Export versions are available for 220-volt, 50-60 cycle power sources.

TRANSISTOR TESTER KIT

Paco Electronics Company, Inc., Glendale, New York is offering a transistor and crystal diode tester in kit form.

The Model T-65 has been designed especially for electronic and communication maintenance as well as technical education. It offers comprehensive tests for I_{CBO} , gain, leakage, shorts, etc. on low-, medium-, and high-power transistors of both the *p-n-p* and *n-p-n* types.

When assembled, the instrument measures 7" x 11½" x 5". It is housed in a ripple finished, steel cabinet with a two-color panel. A wide-angle 5½-



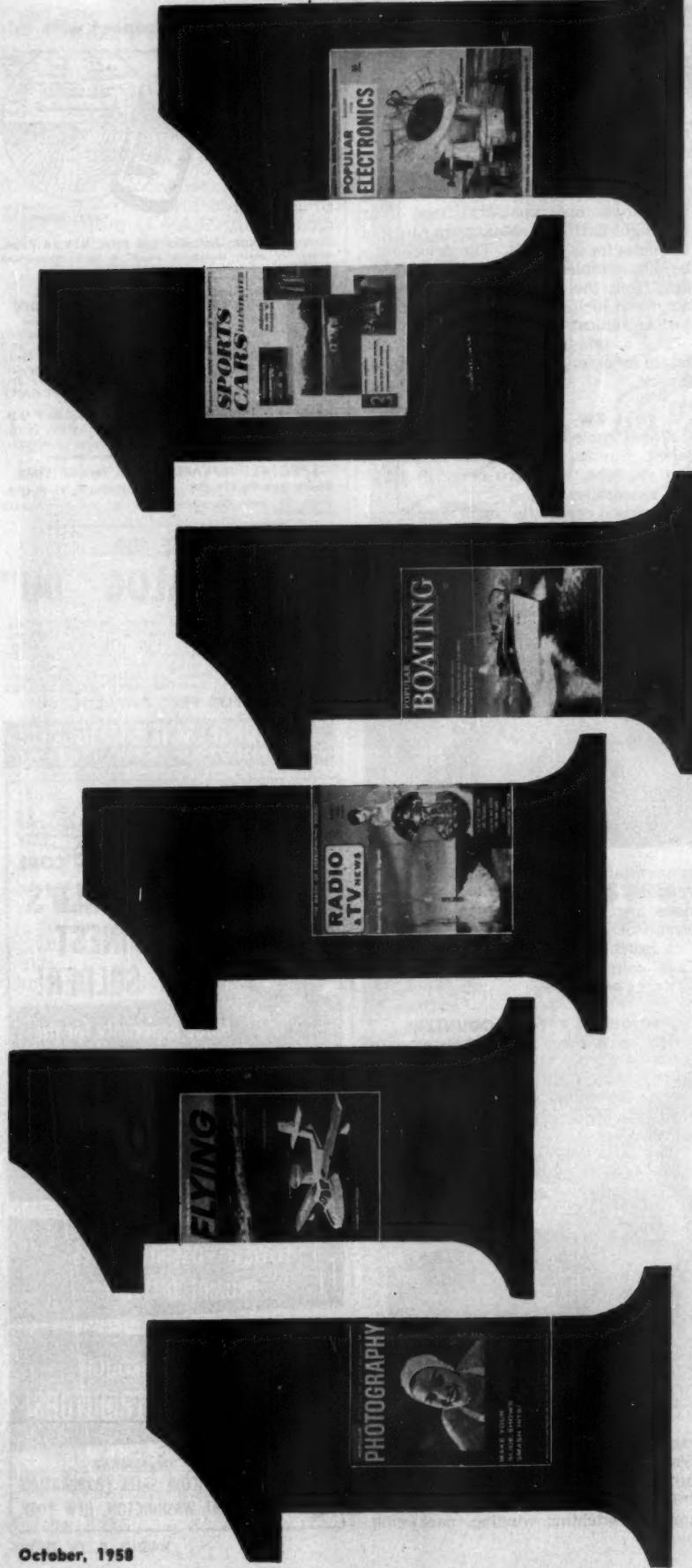
inch 100 μ A. meter is the indicating device. Power requirements are 117 volts at 50/60 cycles.

The kit comes complete with all parts and hardware plus all necessary transistor and crystal diode test data.



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October, 1958

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A comprehensive manual contains detailed step-by-step instructions on assembly and operation.

TRANSISTORIZED METAL LOCATOR

A new transistorized pipe locator and metal detector is being marketed by Gardiner Electronics Co., 2545 E. Indian School Road, Phoenix, Ariz.

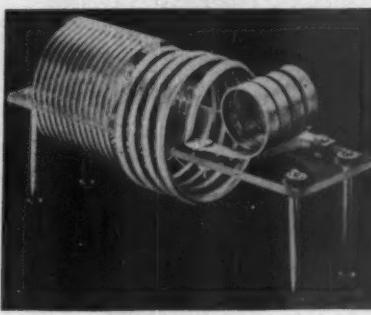
The circuit employs a total of eight transistors and operates from four flashlight batteries. Maximum range of the detector is 21 feet. The device may be disassembled for easy portability to and from the operating site. The instrument includes a pair of headphones and an indicating meter.

For a data sheet on the Model 162 metal detector, write the manufacturer direct.

1 KW. COIL ASSEMBLY

Illumtronic Engineering, 680 E. Taylor St., Sunnyvale, Calif. has announced the availability of two new "Pi Dux" coil assemblies.

Designed especially for pi output circuits in commercial, laboratory, and amateur transmitters, the new units



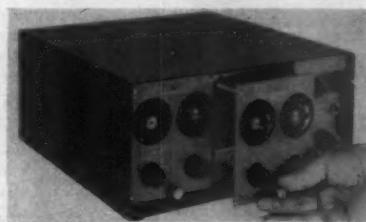
are available in both 1000- and 500-watt versions. The high-frequency coil sections are silver-plated for high tank-circuit efficiency.

A brochure on these and other "Air Dux" coils is available from the manufacturer on request.

MODULAR PRE-SET COUNTERS

The Erie-Pacific Division of Erie Resistor Corp., 12932 S. Weber Way, Hawthorne, Calif. has developed a unique line of pre-set electronic counters featuring a new approach to modular design.

The Model 320 series is available in every size from 2 to 6 digits in the standard line. Each standard instru-



ment consists of an amplifier and control unit, plus any combination of plug-in two- and three-decade modules.

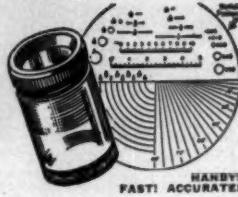
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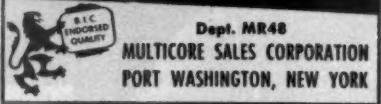


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RADIO & TV NEWS

and other control functions, the unit will operate at a maximum rate of 5000 counts-per-second, accepting any standard waveform. Either a.c.- or d.c.-coupled inputs may be selected from the front panel. Input pulse widths as short as 1 microsecond will give adequate drive. A photocell input is provided.

Further information on these new units is available either from the parent company at 644 W. 12th St., Erie, Pa. or from the Hawthorne plant of the Division.

SUPERIOR V.T.V.M.

Moss Electronic Distributing Co., Inc., 3849 Tenth Ave., New York 34, N. Y. has announced a new 6" full-view-meter vacuum-tube voltmeter, the *Superior Model 77*.

The instrument features printed circuits, a 12AU7 as the d.c. amplifier and two 9006's as peak-to-peak voltage rectifiers, a selenium rectifier power sup-



ply to reduce heat and its subsequent component damage, plus precision 1% zero-temperature-coefficient resistors in the multiplier circuits.

There are seven d.c. voltage ranges (0 through 1500 volts) at 11 megohms input resistance; seven a.c. voltage ranges (0 through 1500 volts r.m.s.), six a.c. voltage ranges (0 through 2000 volts peak-to-peak), seven ohmmeter ranges, three decibel ranges (-10 to +18, +10 to +38, +30 to +58) all based on 0 db = .006 watt into a 500-ohm line; and zero-centered metering for discriminator alignment.

The Model 77 comes completely wired and calibrated with all accessories, including a portable carrying case. A data sheet with complete descriptive details on this v.t.v.m. is available without charge upon written request.

MOBILE REPLACEMENT SUPPLY

A transistorized power supply for use as a replacement for mobile transmitter-receiver power supplies of the vibrator and/or dynamotor type has been introduced by the Industrial Products Division of I. T. & T., 15191 Bleedsoe St., San Fernando, Calif.

The Type QH-051 is a lightweight, compact d.c.-to-d.c. conversion unit that will power a medium- or high-power transmitter in usual ICAS rated

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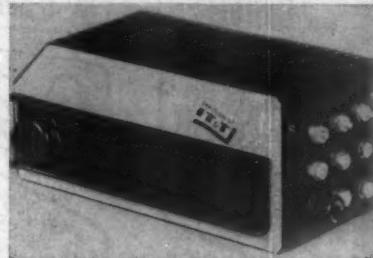
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alliance
TENNA-ROTOR



service and a receiver in CCS duty. The unit requires a d.c. input of 12.6 volts at 9 amps. for rated output to 12 amps. maximum input for 150 watts output. The unit will operate on input voltages as low as 6 volts d.c., with reduced output.

The power supply is housed in an aluminum case measuring 4 1/4" x 7 1/4"



x 3 3/4". Mounting is by means of four captive nuts in the base.

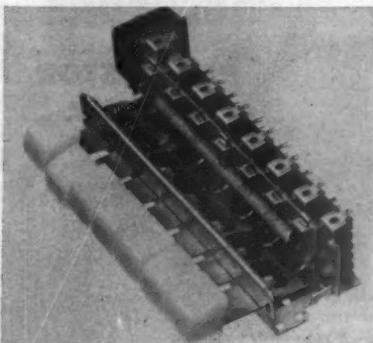
The manufacturer will forward full specifications on this equipment upon request.

PIANO-TYPE SWITCHES

International Electro Exchange, 2307 Foshay Tower, Minneapolis 2, Minn. is acting as U. S. sales agent for a line of push-button switches made in West Germany.

The new piano-type units can be supplied with from 2 to 12 push-buttons and 2, 4, or 6 poles. They are available with "a.c.-on-off" switches and lighted push-buttons if desired. Other types handle up to 18 push-buttons in one row and each button up to 8 poles.

The switch shown in the photograph measures 5" wide, 2 1/4" deep, and 1 1/4"



high. It weighs 7 1/2 ounces. The U. S. distributor will supply full details on any or all of the units in the line upon request.

TRANSISTOR CHECKER

Valor Instruments, Inc., 13214 Crenshaw, Gardena, Calif. has recently introduced a transistor checker of unique design which permits the rapid identification of a faulty transistor.

The checker provides instantaneous "go—no-go" indication and is compact and inexpensive. Both standard JETEC base and power transistors may be plugged in. In addition, the checker may be used for measuring leakage currents and breakdown voltages as well as identifying the transistor type.

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This year's edition is bigger than ever—180 pages of useful information, arranged conveniently into sections on tuners, amplifiers and preamps, record players, changers, turntables, tone arms, cartridges, tape recorders, loudspeakers and systems, enclosures and equipment cabinets.

In addition to listings, the **HI-FI DIRECTORY & BUYERS' GUIDE** contains helpful articles and features on what to look for, how to buy, advantages and disadvantages of different models, how to judge quality and recognize a bargain. Whether you're a hi-fi beginner or a veteran audiophile, this publication is worth its weight in diamond stylus to you. Yet it costs only \$1.00. Be sure to pick up a copy at your favorite newsstand, hi-fi salon or electronics parts dealer.



The **HI-FI DIRECTORY & BUYERS' GUIDE** is on sale in October—watch for it!

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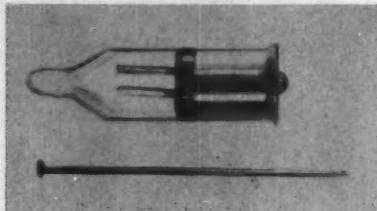
cians, hobbyists, mechanics, etc., the unit will magnetize or demagnetize screwdrivers, nut runners, hammers, pliers, small wrenches, probes, tweezers, etc. in 10 seconds. The unit operates from any 117-volt a.c. line and comes complete with instructions and a written guarantee.

For illustrated literature on the Model F-100, write the manufacturer direct.

SUBMINIATURE NEON LAMP

Circon Component Corporation, Santa Barbara Municipal Airport, Goleta, Calif. is now offering a subminiature neon lamp which requires no series resistor nor external ballast.

The NE2R incorporates current control as an integral part of the internal lamp structure. The lamp measures



only $\frac{1}{4}$ " in diameter and less than 1" long. It has a midget flange base which is readily interchangeable with many assemblies already installed in equipment.

The new lamp has a life expectancy in excess of 25,000 hours. Its operation is cold and generates practically no heat. Power consumption is 1/10th watt with a design current of 1 ma.

The NE2R is available in production quantities.

TRANSISTOR-PORTABLE KIT

Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. has added a 5-transistor portable radio to its line of "Knight-Kits."

Supplied with all parts, the kit package includes a compact ivory-and-black plastic case, with gold-finished end plates and pull-out carrying handle. The orderly chassis layout, plus use of a printed-circuit board provides easy access to all parts and the battery. In



addition, the printed-circuit board simplifies and speeds assembly, eliminating the possibility of wiring errors.

The circuit employs five transistors, a class B push-pull audio output stage which drives a $3\frac{1}{2}$ -inch speaker, a ferrite loop antenna, and phone-jack output for earphone listening, if desired. The company estimates that the single 9-volt battery will provide up to 200 hours playing time.

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A basic principle for making money is to have something work for you, rather than you yourself do the work. As an operator of a FAST-CHECK SELF SERVICE TUBE TESTER route you can be the profit master and avoid fast growing businesses . . . earning money for you while you take life easy. Business can be operated from home and during spare time. All you do is make calls once a week to restock testers and collect profits.

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Century's self-service tube testers check and sell TV and radio tubes automatically in 15 hours a day—7 days a week. Operators do their own testing and defective tubes are replaced on the spot for highly profitable sales. You place testers and tube stock in stores on consignment . . . and each one can net up to \$1000 a year.

Retail stores welcome self-service testers

Drug stores, luncheonettes, supermarkets, candy stores, hobby stores, etc. welcome having a tube tester placed in their store because of the extra traffic it attracts and the commission they earn.

FREE booklet tells all about this booming business. If you are interested in starting a lifetime business, then ACT NOW and send for FREE booklet to convince yourself that this is today's greatest business opportunity.

DON'T DELAY . . . MAIL COUPON TODAY

CENTURY ELECTRONICS CO., INC.

Dept. T-10, 111 Roosevelt Ave., Mineola, N.Y.
Please send me FREE booklet and particulars
about setting-up a self-service tube tester route.

Name

Address

City State

The receiver measures 3 $\frac{3}{4}$ " x 7 $\frac{1}{2}$ " x 1 $\frac{1}{4}$ " and weighs 22 ounces. It is catalogued as the 83 Y 766. Write the company for full details.

SECO'S V.T.V.M.

Seco Manufacturing Company, 5015 Penn Avenue South, Minneapolis, Minn.

is now in production on a new v.t.v.m. which incorporates several features unique in service-type test instruments.

The Model 208 has a large, easy-to-read 4 $\frac{1}{2}$ -inch 200 μ A. meter, mounted on a sloping panel, and provides seven d.c., seven a.c., and seven ohm ranges in addition to a special EIA ohm scale to check standard color-coded resistance values and tolerance limits. Accuracy is $\pm 3\%$ on all scales.

The unit incorporates a specially designed "shift-lever" function switch with all functions clearly marked and cleanly separated by positive stops for each position. Color-coding on the function switch identifies the proper probe—with the switch automatically connecting the proper probe for each function and isolating the probe not in use.

The instrument is housed in an all-metal shielded case which measures 5 $\frac{1}{4}$ " wide, 8 $\frac{1}{2}$ " long, and 3 $\frac{1}{2}$ " high. A leather, felt-lined carrying case is available at extra cost.

B&K TRANSISTOR TESTER

B&K Manufacturing Co., 3726 N. Southport Ave., Chicago 13, Ill. has announced the availability of a new and improved professional-type transistor tester, the Model 150.

The instrument accurately measures junction transistor beta, the actual grounded-emitter current gain. The meter reads directly in beta. Accuracy is within $\pm 5\%$, the measurement being made with a calibrated and small a.c. signal. The built-in generator contains



a transistorized 1000 cps oscillator with buffer amplifier for isolation. Provision for calibrating its output is handled on the front panel.

The two beta scales read 0-50 and 0-250. Leakage current, I_{ce} , is read directly on the meter scale, 0-2 ma. for power transistors and 0-50 μ A. and 0-200 μ A. for other transistors.

The instrument measures 14" x 8 $\frac{1}{2}$ " x

October, 1958



RECEIVERS

RAX-1 Four Band, 4/ $\frac{1}{2}$ "	Unit #1 200-1500 KC—Used.....	\$18.95
Dial, A.V.C., C.W., M.C.W., Phone Jack, Volume Control, Volume Indicator, 24" x 8", 200 V S. MA, Complete with 7 Tubes, less top cover. Good condition: Size: 16 x 7 $\frac{1}{2}$ x 7 $\frac{1}{2}$ "—Illustrated—	Unit #2 1500-2000 KC—Used.....	18.95
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R-26/ARC-5 Receiver—100 to 1500 MC—Used.....	R-28/ARC-5 Receiver—100 to 1500 MC—Used.....	18.95
ARB Receiver—100 to 9050 KC—Used.....	ARB Receiver—2 to 6 MC—Used.....	18.95
(For details, see last month's ad or send for catalog.)	BC-652 Receiver—2 to 18 MC—Used.....	24.95
BC-312/342 Receiver—1 to 18 MC—Used.....	BC-312 FM Receiver—20 to 28 MC—New.....	79.50
BC-312 FM Receiver—20 to 28 MC—Used.....	BC-312 FM Receiver—20 to 28 MC—Used.....	19.95
BC-688 FM Receiver—27 to 58 MC—Used.....	BC-3050 FM Revr—30 to 50 (10 MC Spread) N—Used.....	24.95
BC-1200 Receiver—200 to 400 KC—U—Used.....	BC-1200 Receiver—200 to 400 KC—U—Used.....	29.95
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BC-1154 AM—50 Watt—53.3 to 95 MC—Used.....	U: \$39.95
T-23/ARC-5—100 to 150 MC—Used.....	U: \$19.95
BC-457 AM/Comm.—4 to 5.3 MC—Used.....	U: \$4.95
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Navy Type AM/Comm.—2.1 to 3 MC—Used.....	U: \$7.95
Navy/BC-450 AM/Comm.—7 to 8 MC—Used.....	U: \$7.95

MOUNTINGS and RACKS:

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FT-238 Mtg. for BC-605 & BC-610—Used.....	9.95
FT-220 for Command or ARC-5—Used—Received.....	9.95
FT-152 for BC-312 & BC-342—Used.....	2.50

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T-26 Microphone F-1 Button—New: \$1.95	Used: 1.25
HS-90 Headset—New: \$1.50	Used: .75
Lip Mic—New: \$1.50	Used: 1.00
Throat Mic—New: .75	Used: .50

TS-18 Handset—New: \$4.95	Used: 2.95
T-26 Microphone F-1 Button—New: \$1.95	Used: 1.25
HS-90 Headset—New: \$1.50	Used: .75
Lip Mic—New: \$1.50	Used: 1.00
Throat Mic—New: .75	Used: .50

TS-17 Handset—New: \$4.95	Used: 2.95
TS-18 Handset—New: \$4.95	Used: 2.95
T-26 Microphone F-1 Button—New: \$1.95	Used: 1.25
HS-90 Headset—New: \$1.50	Used: .75
Lip Mic—New: \$1.50	Used: 1.00
Throat Mic—New: .75	Used: .50

TS-18 Handset—New: \$4.95	Used: 2.95
T-26 Microphone F-1 Button—New: \$1.95	Used: 1.25
HS-90 Headset—New: \$1.50	Used: .75
Lip Mic—New: \$1.50	Used: 1.00
Throat Mic—New: .75	Used: .50

TS-17 Handset—New: \$4.95	Used: 2.95
TS-18 Handset—New: \$4.95	Used: 2.95
T-26 Microphone F-1 Button—New: \$1.95	Used: 1.25
HS-90 Headset—New: \$1.50	Used: .75
Lip Mic—New: \$1.50	Used: 1.00
Throat Mic—New: .75	Used: .50

TS-18 Handset—New: \$4.95	Used: 2.95
T-26 Microphone F-1 Button—New: \$1.95	Used: 1.25
HS-90 Headset—New: \$1.50	Used: .75
Lip Mic—New: \$1.50	Used: 1.00
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DECade Boxes

The Distributor Division of Aerovox Corp., New Bedford, Mass. has introduced a new and complete line of decade boxes especially designed for every laboratory and testing application.

Ten models comprise the line which includes three capacitance models, three resistance models, and four inductance models. Designed with precision components and of heavy duty construction, the new units provide long, trouble-free operational life, according to the company.

The exterior appearance is designed to complement other laboratory test instruments. Face plates are treated in black backgrounds with white lettering for maximum legibility. Multiple dial units have the highest value multiplier on the left-hand side so that readings are in order, as taken.

The company's local distributors are handling the line with additional information available on request from the Division.

Stereomaster 130

(Continued from page 48)

hand speaker, and both speakers must always be in phase. When in-phase, the sounds from both speakers would be additive while out-of-phase they would tend to cancel out. Proper phasing can be achieved mechanically when hooking up the hi-fi stereo system. If stereo discs and recorded stereo tapes were standardized with regard to proper placement of the left- and right-hand channels, we would not require a stereo reversal switch. Unfortunately standards are still lacking. We have run across quite a few stereo tapes that were not recorded in accordance with more common practice and it was found that the stereo reversal feature was quite useful in that the left- and right-hand speaker systems could be interchanged without difficulty.

To simply play stereo program material one would not require any further flexibility of his preamplifier. However, there are many occasions when the hi-fi enthusiast would like to play single-channel material, whether a record, tape, or possibly an FM broadcast, and be able to reproduce any of these through either one of the speaker systems or have them combined to be reproduced through both outputs. Also, it would be particularly nice to be able to mix, for example, two programs—especially for recording purposes.

The balance control on any stereo preamplifier has a very important function to perform and should certainly not be omitted. Most tapes, and we're not too sure as yet about discs, unfortunately have quite a variation in the recording balance between the two channels and it is a rare occasion when one finds identical levels in a number

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Power: 50 watts.

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Finish: Baked Enamel. Wt.: 4.0 lbs.

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RADIO & TV NEWS

of recorded tapes. For this reason, one should have available a control for balancing the recorded material properly in addition to the master volume control to raise or lower the output levels of both channels simultaneously.

A phase control (which inverts the phase of one of the channels without interchanging the channels) might not necessarily be classed as a "must" item, but there have been cases when the phase of one channel of a recorded tape would shift back and forth during transition from one selection to another. A phase reversal control would, of course, solve this problem but we believe that the recording companies will soon eliminate this situation by standardization.

When it comes to rumble and scratch filters and tone and loudness controls, the advantages and disadvantages are similar to those previously described for monaural playback.

The third, or center channel, output could be considered as more or less of a convenience. One could insert an external matching network between the two channels to hook up a third speaker system. If this feature is supplied as part of a preamplifier it simply offers additional convenience.

The foregoing are some of the important features available in stereo control units. Whether or not all of these features are desirable is up to the individual user of such equipment—and whether or not his budget can be stretched to include such conveniences.

One thing is certain—the "Stereo-master 130" reported here provides all the features that one could possibly want.

Over and above its mechanical features and flexibility the most important quality of a preamp is, of course, good performance. No preamplifier, for example, although it has all of the flexibility that one could desire, is worth its salt if the electronic performance is poor. With this thought in mind and following our customary procedure, this preamplifier was thoroughly checked under laboratory conditions. The results are as follows:

Sensitivity: .033 v. for 1 v. output on tuner input and .0012 v. for the magnetic input.

Hum and Noise: For tuner input -65 db and for magnetic input -53 db, referred to 1 volt. These hum figures were with shorted inputs. For open circuited condition the hum and noise figures were -63 db and -49 db respectively.

The second channel hum and noise figures were approximately the same for magnetic inputs but for tuner input they were slightly higher: -59 db for both open and shorted input conditions.

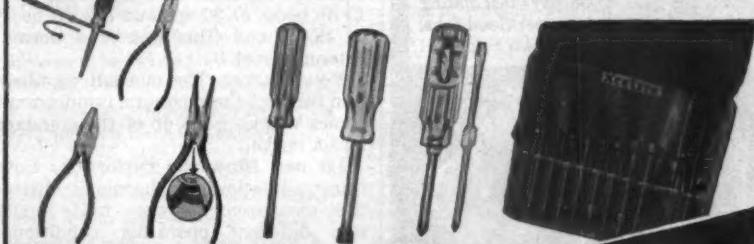
Frequency Response: $\pm .25$ db from 30 to 15,000 cps. It is interesting to note that Scott followed its usual procedure in incorporating a sharp cut-off rumble filter within the circuit of both Channels A and B. This filter is wired directly into the circuit and is in addition to the rumble filter control mounted on the front panel. The frequency response



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200-400 MC. 10-channel. Crystal controlled. MOTOR TUNING. Model MAR. 10 W. output. Three (3) units to set.

Used. All-for-one \$75.00

RDZ RECEIVER

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measurements show that the output of the preamplifier is down 14 db at 10 cps.

Rumble Filter: -21.5 db at 20 cps. This is an extremely sharp cut-off considering that the effect of this rumble filter at 100 cps is a reduction of only 1.4 db from flat response.

Bass Control: -19 db to +14.4 db from minimum to maximum positions of the control at 30 cps.

Treble Control: -19 db to +16 db from minimum to maximum positions of the control at 15,000 cps.

Scratch Filter: -5 db at 5000 cps; -6.3 db at 10,000 cps; -11 db at 15,000 cps; and -16 db at 20,000 cps.

Loudness Control: This unit incorporates a design that not only boosts the low-frequency end of the audio spectrum but, in addition, provides boost at the high end. We obtained a 13 db boost at 30 cps and a 9 db boost at 15,000 cps. This was at a normal listening level.

Equalization: The over-all equalization through the magnetic input circuit comes within ± .65 db of the standard RIAA curve.

IM and Harmonic Distortion: Both intermodulation and harmonic distortion measurements were made under two different operating conditions: "average," 1 volt in and 1 volt out; and "maximum," .5 volt in and 2 volts out. In the latter case the input level control was adjusted to provide the necessary output. Under these two conditions the intermodulation distortion for tuner input is .095% and .16% respectively.

The harmonic distortion for "average" operating conditions is .33% at 20 cps, .12% at 1000 cps, and .26% at 20,000 cps. For "maximum" operating conditions, the harmonic distortion is .31%, .25%, and .67% at the same frequencies.

Channel Separation: 50 db.

The above specifications show the actual electronic performance of Channel A only. Channel B was checked for every one of the tests indicated above and there were slight variations here and there. However, none of them was worth mentioning. Basically, the two channels are identical.

All of the function switches and controls performed their normal operation without annoying "clicks," "pops," etc. From all the lab data and listening tests we are convinced that this is one of the best stereo preamplifiers that we have checked.

—50—



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RIDER BOOKS AND MANUALS

PORTABLE AND CLOCK RADIOS, by Ben Crissus and David Gressin. You can learn all about portable and clock radios—their circuitry, their repair, in this modern book. Beginning with typical portable radio circuits, emphasis is placed on filament circuitry and how major problems of current dispersion are handled. Transistor circuitry is covered. Stress is placed on portable radio power supplies for battery circuits and battery and AC-DC circuits. Numerous battery testing techniques explained. Covers repair, replacement and alignment plus a detailed discussion of probable mechanical troubles, replacement procedures and short-cuts. Tips on extending the life of the set are discussed. Clock radios, their circuitry, a wide variety of clock movements, how to adjust them and locate defects also covered. Tips on cleaning and lubricating clock mechanisms. #224. \$2.75.

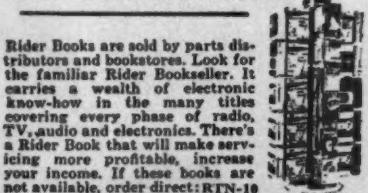
HOME AIR CONDITIONING—Installation & Repair by J. Derman, F. Makstein, H. Seaman. This modern, completely practical text by three experts in the field of home air conditioning, enables anyone to understand the organization, operation, installation and repair of all types of home air conditioners. Starting with the principles of the process of cooling air, it covers all facets of home air conditioners.

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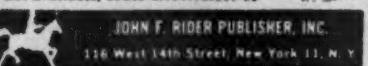
FUNDAMENTALS OF TRANSISTORS (second edition) by Leonard M. Krugman, P.E. Published in 1954, the first edition of this book gained an international reputation as an outstanding text devoted to the fundamentals of transistors—their characteristics, performance and application. One of its main features was the lucid presentation of the theory of semi-conductors. This, the second edition (revised and expanded), modernizes the text so as to embrace the latest developments in the transistor art and so bring the book completely up-to-the-minute. The numerical examples contained in this book make every equation both understandable and usable. The tremendous number of transistorized devices—radios, amplifiers, etc.—that require a knowledge of transistors makes this **MUST READING FOR EVERY TECHNICIAN**. #160, soft cover, \$3.50.

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GAS TUBES edited by Alexander Schure, Ph.D. The growing importance of gas tubes in industrial electronic applications makes a thorough knowledge of them a must. This book, the latest in the famous Electronics Technology Series, describes the various types of gas tubes, their physical construction and applications in a remarkably thorough and understandable manner. Starting with an explanation of ionization in gases, the text covers the role of ions, gas conduction and arc discharge in gas tubes. Gaseous rectifiers are fully described and compared with high vacuum rectifiers. The effect of gas on the thermionic tube and the value of mercury vapor in rectifiers are covered. The text details the use of gas tubes as highly effective voltage regulators, with examples of the circuitry involved. Triode thyatrons, their construction, operation and application are explained. Other types of gas tubes and their related circuitry covered in this text include: gas-filled phototubes, cold-cathode gas tubes, mercury pool rectifiers and ignitrons. #166-24, \$1.50.



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					19	20
					26	27

CALENDAR of EVENTS

SEPTEMBER 30-OCTOBER 4

1958 New York High Fidelity Music Show. Sponsored by the Institute of High Fidelity Manufacturers. New York Trade Show Building. Open to the public at nominal admission fee. This year's Show theme is "The Age of Stereo."

OCTOBER 1-2

Engineering Writing & Speech Symposium. Sponsored by IRE and PGWES. Hotel Biltmore, New York City. Details from H. B. Michaelson, IBM Research Center, Box 218, Yorktown Heights, New York.

Conference on Radio Interference Reduction. Sponsored by Armour Research Foundation and U. S. Army Signal Engineering Laboratories. Museum of Science and Industry, Chicago. Additional details from Conference Secretary, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill.

OCTOBER 8-9

IRE Canadian Convention. Sponsored by Region 8 of IRE. Exhibition Park, Toronto, Ont. Program information available from A. P. H. Barclay, % convention headquarters, 1819 Yonge St., Toronto, Ontario.

OCTOBER 13-15

National Electronics Conference. Sponsored by AIEE, IRE, Illinois Institute of Technology, University of Illinois, Northwestern University. Hotel Sherman, Chicago. Further information available from A. H. Streich, general manager, NEC, 84 E. Randolph Street, Chicago 1, Illinois.

OCTOBER 20-22

URSI Fall Meeting. Sponsored by National Academy of Sciences, National Research Council, and IRE Professional Groups. Pennsylvania State University, University Park, Pa.

OCTOBER 27-28

Fifth Annual East Coast Conference on Aeronautical and Navigational Electronics. Sponsored by the IRE, Lord Baltimore Hotel, Baltimore, Md.

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Within the Industry

(Continued from page 24)

pany . . . The appointment of BRUCE F. GRIMM, JR. as sales manager for precision controls has been announced by Clarostat Manufacturing Co., Inc. . . . EDWARD C. CALIGURI is now assistant sales promotion manager of Zenith Radio Corporation . . . R. WILSON has been named manager, communications manufacturing, RCA . . . Thompson Products, Inc. has named JOHN B. GATES general sales manager of the firm's Michigan group . . . The appointment of ADMIRAL JAMES E. LEEPER, United States Navy (Ret.), as vice-president of Philco Corporation has been announced . . . HAIRNE F. WARD, JR. has been named market research manager of the professional products division of Ampex Corp. . . . Election of two new administrative vice-presidents at International Telephone and Telegraph Corp. has been announced. The new officers are: CHESTER E. JOHANSEN and WILLIAM T. RAPP . . . EUGENE PARKS has been named sales manager of Electro Tec Corp. . . . The Industro Transistor Corp. announces the appointment of ANTHONY F. BISGOOD as chairman of the board of directors . . . RALPH W. AUBIN has been named manager of sales, instruments and components, Laboratory for Electronics, Inc. . . . The retirement of JOHN Q. ADAMS, vice-president, sales, has been announced by CBS-Hytron. Mr. Adams' retirement concludes fifteen years' service with the firm and marks his thirty-sixth year in the radio industry.

anniversary this year . . . PACIFIC SEMICONDUCTORS, INC. has opened new regional sales offices at 8271 Melrose Avenue, Los Angeles, Calif. . . . Acquisition of a 40,000-square-foot plant has been announced by the semiconductor division of HOFFMAN ELECTRONICS CORPORATION. The one-story brick structure is situated on a two acre plot at 2205 Lee Street, Evanston, Ill. . . . AMPEX CORPORATION announces the opening of the first of its new professional products division parts and service depots at 345 E. 48th St., New York City.

J. B. ANGER has joined Zenith Radio Corporation as merchandise manager, according to an announcement by the firm's vice-president and director of sales.

Prior to this, Mr. Anger was associated with Motorola, Inc. He joined the organization in 1952 as national sales training manager, sponsoring a "workshop" technique of training sales personnel. In 1954 he was appointed assistant general sales manager and finally national sales manager of the company's radio and phonograph division.

From 1947 to 1950 Mr. Anger was northwestern regional sales manager for the "Norge" division of Borg-Warner Corporation and from 1950 to 1952 was that company's national sales training manager.



ELECTRONIC INDUSTRY SHOW CORPORATION has compiled an up-to-date 1958 master list of distributors in three categories—electronic parts, commercial sound, and high-fidelity—which is on its way to all exhibitors who participated in the 1958 Electronic Parts Distributors Show.

Designed as a reference tool to help manufacturers know who and where important distributors are, the list is set up alphabetically by state, city, and company. It is for the exclusive use of show exhibitors and the trade associations which sponsor the Corporation.

The master list includes about 2500 companies which qualified for admission to this year's show.

GENERAL RADIO COMPANY has broken ground for a new addition to its West Concord, Mass. plant. The property consists of 145,000 square feet of office, manufacturing, and storage space . . . **RAYTHEON MANUFACTURING COMPANY** plans to lease 400,000 square feet of space in the Dighton Industries, Inc. property in North Dighton, Mass. The area will be used to meet the need for increased manufacturing capacity for the government equipment division of the firm . . . **ELKAY PRODUCTS COMPANY** will construct a new, one-story plant in Springfield, New Jersey, off Route 22. The firm celebrates its 30th

H. H. Scott, Inc. announces the completion of a new 32,000-square-foot plant in Maynard, Mass. Located on Route 62, the plant is of simple, modern design and is constructed of brick with spectrum colored panels along the side walls. The building has complete facilities for the manufacture and fabrication of electronic equipment and includes machine and sheet metal shops, coil transformer, testing, and electrical assembly departments, plus office and storage space and a completely staffed engineering development laboratory. Facilities are also included for production and model shop work on electronic instruments and equipment.



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